PLANT PRODUCTION

MOORE AND HALLIGAN

MOORE AND HALLIGAN'S PLANT PRODUCTION

EDITED BY

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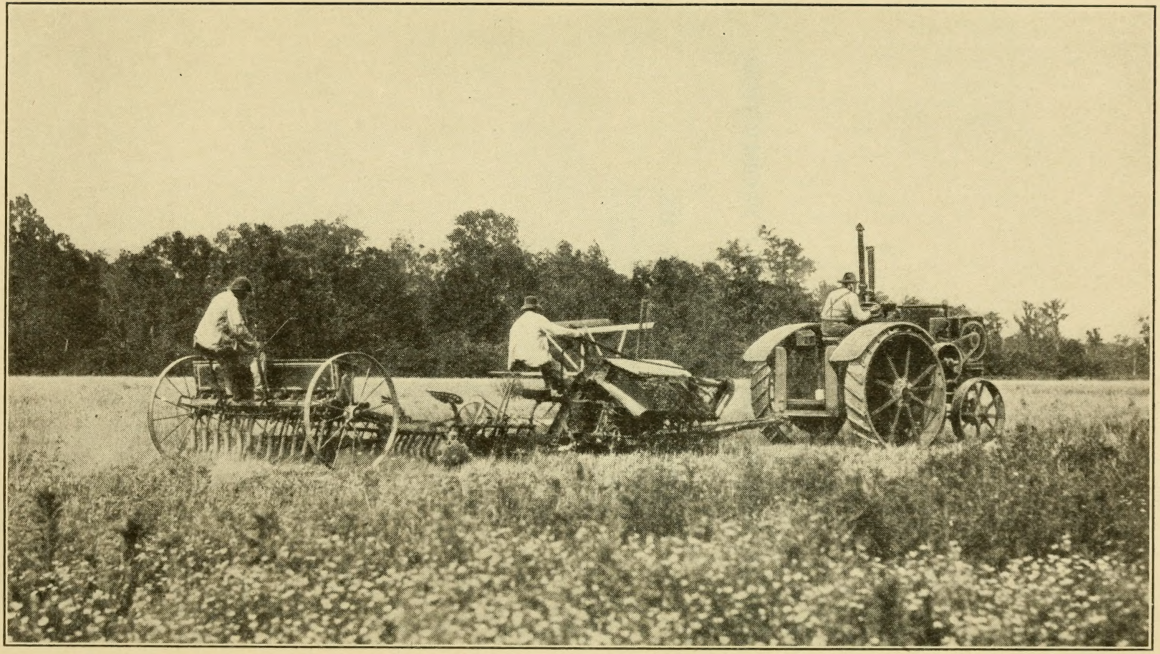

Tractor drawing a procession of implements consisting of binder, disk harrow, and seeder. The oats are harvested by the binder and picked up by a wagon later. Behind the binder the disk harrow makes a new seed bed, while bringing up the rear is the seeder putting in peas.

PLANT PRODUCTION

PART I — AGRONOMY
PART II — HORTICULTURE

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GENERAL INTRODUCTION

THIS series of agricultural texts is based on the theory that the successful farmer should know the physical and biological forces with which he has to contend; that he should understand the laws under which these forces operate; and that he should acquire some skill in directing them. He should ultimately become able to adjust and correlate these forces so as to bring them all under the orderly operation of economic law. In conformity with the above theory this series has been made to cover the following fundamental divisions:

The science and art of producing agricultural plants.

The production, care, and management of farm animals.

The establishment and conservation of soil fertility, with the chemistry of the same in relation to plant and animal production.

The proper balance and combination of these three aspects of agricultural production, in the business management of the farm.

What Vocational Agriculture Demands. — Vocational training in agriculture should differ from trade instruction in one most important regard: trade training develops skilled workers for the various branches of an industry; it neither develops, nor aims to develop, factory managers. It usually deals with parts of the construction, less frequently with the finished product, and more rarely still with the management of the manufacturing plant. Vocational agriculture, on the other hand, must train for the operation of the whole plant, as the farm is a unit in itself. The trained farmer must be skilled, not only in the arts of his varied industry, but also in the scien-

tific management of the entire farm. Added to skill there must be knowledge and understanding.

What the Federal Law Requires. — Under the Smith-Hughes law passed by Congress early in 1917, vocational instruction in agriculture — to quote its language — "must provide for directed or supervised practice in agriculture either in a farm provided by the school or other farms for at least six months per year." There can be no question as to the meaning or the intent of this law. It demands that agricultural instruction shall be *useful*, *practical*, and of *immediate application*.

What This Text is Designed to Accomplish. — The authors of this book have long held the opinion that is expressed in the Smith-Hughes law and made a condition of its fulfilment. They have therefore made radical departures from the usual style of textbook construction. In addition to the informational material, emphasis is placed on frequent sets of *Exercises* intended to provoke class discussion and to direct attention to the established practices on the home farm. Following these exercises are lists of *Home Projects* designed to suggest how the lessons gained from study of the text may be turned at once to practical account.

It is believed that by following the plan set forth in this volume teachers of vocational agriculture may fulfil the most vigorous demands of the Smith-Hughes law. It is hoped that students may also find herein something of inspiration, as well as of immediate practical use.

KIRK LESTER HATCH.

PREFACE

Agronomy. — The farm crops of a country are the foundation of its agriculture. All farm boys and others interested in agriculture should make a careful study of these crops. The Field Crops Section of PLANT PRODUCTION is designed for those who desire a plain practical treatise on the various field crops. Only the more important economic plants have been discussed. The aim of the authors has been to present the subject matter in such simplified form that there will be no doubt as to its meaning in the mind of the reader. The various home projects presented will enable the student to put what he has learned into actual practice.

The simple truth concerning the growth of farm crops, impressed upon the student as nature unfolds to him her secrets, should develop interest in agriculture and a better understanding of the many interesting facts of science continually unfolded before our eyes in the everyday world in which we live.

After many years of teaching experience with young people from the farms, the authors have endeavored to put into book form the methods which proved most successful in impressing young people with the value and importance of pure-bred seeds and the best practice in the growing and handling of farm crops.

Horticulture. — The text in horticulture aims to present in a simple, direct, and logical manner the basic principles governing its practice, with such typical, suggestive questions, problems, and exercises on the text as might be used for class work.

This branch of agriculture, dealing as it does with consideration of the individual plant as a unit, is most adaptable to peda-

gogical practice, and is an excellent foundational study for general agriculture.

The teacher will find that it can readily be adapted to local conditions, emphasizing the particular part that is of most importance in the locality. However, one should not overlook the general educational value of the subject matter that is not of economic importance in the immediate neighborhood.

In country districts where fruits may be grown successfully this particular portion of the text may be emphasized, while in other country sections vegetable gardening may prove of greater interest. Under such conditions the primary aim of the teacher should be to arouse interest and enthusiasm for this work rather than to emphasize the presentation of an endless list of cultural facts.

In the town or city the more intensive phases of the work, such as the growing of crops under glass, may prove most appealing. Here, too, a study of the ornamental trees and plants will arouse an interest in and respect for these things in the work of civic development.

R. A. MOORE.
C. P. HALLIGAN.

CONTENTS

PART I. AGRONOMY

CHAPTER		PAGE
I.	The Soil and the Plant	11
II.	Corn	17
III.	Corn and Grain Judging	41
IV.	Wheat	67
V.	Barley	79
VI.	Oats	91
VII.	Rye	101
VIII.	Buckwheat	107
IX.	Grain Breeding	112
X.	Leguminous Crops	120
XI.	Alfalfa	141
XII.	The Hay Grasses	161
XIII.	Potatoes	174
XIV.	Cotton	188

PART II. HORTICULTURE

I.	Propagation by Seeds and Spores	201
II.	Propagation by Separation, Division, and Layerage	210
III.	Propagation by Cuttings	217
IV.	Grafting	228
V.	Fruit Growing	240
VI.	Orchard Management	253
VII.	Fruit Pests	267

CHAPTER		PAGE
VIII.	Spraying Mixtures	283
IX.	Thinning, Harvesting, and Storing Fruit	291
X.	The Pomes — Apples, Pears, and Quinces	301
XI.	Stone Fruits — Peaches, Plums, and Cherries	310
XII.	Grapes, Strawberries, and Bush Fruits	319
XIII.	Vegetable Gardening	337
XIV.	Manure and Commercial Fertilizers	348
XV.	Tillage and Irrigation	354
XVI.	Glass Structures and Care of Greenhouse Crops	360
XVII.	Seed Sowing and Transplanting	368
XVIII.	Harvesting, Marketing, and Storing Vegetables	376
XIX.	Landscape Gardening	382
XX.	Trees, Shrubs, Vines, and Flowers	398
Appendix		413
Index		417

PART I. AGRONOMY

CHAPTER I

THE SOIL AND THE PLANT

What Plants Get from the Soil. — About 5 per cent of the weight of a plant is made up of elements that come from the soil, and about 95 per cent is composed of elements that come from air and water. The most important elements taken from the soil are nitrogen, phosphorus, potassium, and calcium. The elements that a plant takes from air and water are carbon, oxygen, and hydrogen. When a plant is burned these last three elements and nitrogen disappear into the air. In the ash that remains are all the elements, except nitrogen, that came from the soil. At the outset it is well to keep in mind that although four fifths of the air is nitrogen, plants cannot get this element directly from the air, but obtain it from nitrogen-containing substances in the soil.

What Soil Is. — The soil consists of mineral particles; decaying plants and animals; living organisms, such as bacteria and worms; soil water; and soil air. The mineral particles have been formed by the breaking up and decay of solid rock. Rain, air, frost, and streams are some of the agencies that have changed solid rock into soil. Even earthworms and many other small forms of animal life are active agencies in making soil. The decaying plants and animals form the organic matter of the

soil, which is generally called humus. The soil water and soil air occupy the pores in the soil.

Kinds of Soils. — There are three classes of soils on

Fig. 1. — A rich soil containing much humus.

the basis of the size of the soil particles. Soils made up wholly of very fine particles are called clay soils. Those composed largely of particles of sand are called sandy soils. Soils consisting of large amounts of both clay and sand are called loams. Loams are the most satisfactory soils for most crops, because they are easily cultivated, do not bake, and hold moisture well. Sandy soils dry out rapidly and clay soils bake in the hot sun after heavy rains. The special methods for handling these soils are taken up later in this text in connection with the respective crops best adapted to them.

Color of Soils. — The color of soils is due to decaying organic matter and to mineral substances which they contain. The black color of soil is due mainly to the decaying vegetable matter. Even the red clays turn black when fertilized with barnyard manure for some time.

Black soil is not necessarily, as is popularly supposed, a rich soil. However, a black soil is likely to contain a good deal of humus, which aids greatly in plant growth.

The red color of some soils is due to the red iron oxide they contain. Another form of iron oxide is yellow, and this gives the yellow color so common to clays.

Water in the Soil. — Suppose that we have before us a flowerpot filled with soil that is saturated with water. In this condition the spaces between the soil particles are filled with water and the soil air is thus excluded. Through the opening in the bottom of the flowerpot a large part of the water will drain away. This is called free or gravitational water. After all the gravitational water has dripped away part of the water remains. It exists as thin films around the particles of soil and is called film or capillary water. The capillary water moves in any direction, but always toward the driest portion of the soil. In dry weather the roots of the crops are supplied with moisture from the saturated zone of the ground, which may be several feet down, by the force which we call capillary attraction. Thus the capillary water moves through the soil very much as oil moves through the wick of a lamp.

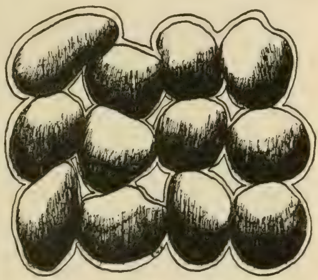

Fig. 2. — Capillary water.

It is the capillary water in the soil that is useful to plants. In soil that is saturated with water, crops cannot thrive because the soil air is excluded. Therefore, it is important that the supply of capillary water be maintained by proper methods of tillage. The ground must be kept in such a

condition that capillary water can move upward from the great reservoir of ground water to the roots of the crops and that excessive evaporation from the surface is prevented. Capillary moisture passes very slowly through a

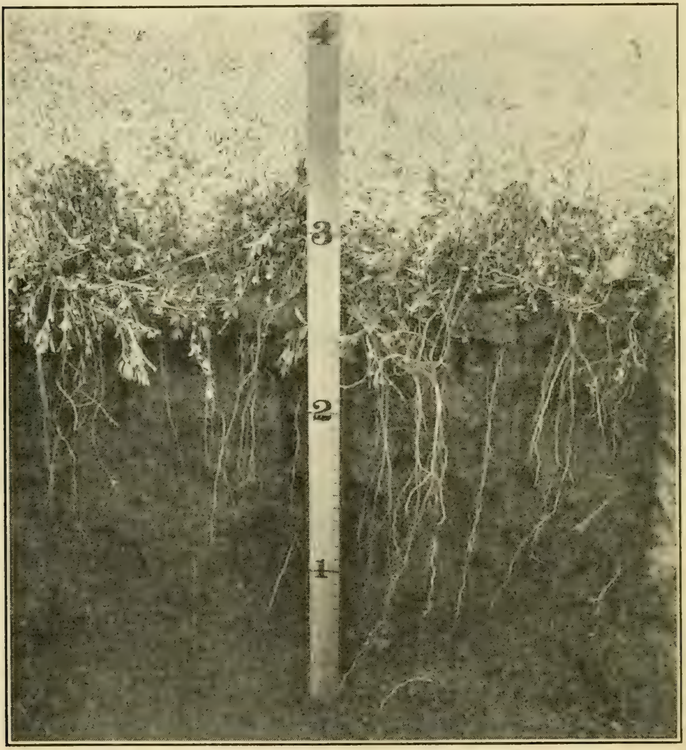

Fig. 3. — Characteristic root growth of alfalfa.

layer of cloddy soil, heavy sod, or coarse manure. Therefore it is necessary before planting a crop that the soil be well pulverized and that there has been sufficient time after plowing for the sod or coarse manure, which has been

turned under, to decay. Excessive evaporation can be prevented by shallow cultivation after a crop has been planted. After a shallow cultivation the fine soil on top dries out quickly; and in a loose, dry condition it acts as a barrier to the upward movement of the capillary water beneath. Thus this layer of fine, dry soil, which is called a soil mulch, acts as a blanket to prevent evaporation. When a soil mulch becomes compacted by a rain it no longer acts as a barrier to capillary water and excessive evaporation begins anew. The ground should be given a shallow cultivation after each rain in order to form a new mulch.

Essential Fertilizers. — The elements needed by plants are found in the soil in sufficient quantity with but three exceptions, nitrogen, potassium, and phosphorus. These exist in the soil in very small amounts, and if plants are continually grown thereon and removed, these substances soon become exhausted. They must be supplied to the land by some means if good crops are to be secured. Barnyard manure is called a complete fertilizer because it contains all of these three elements. It is ordinarily the best fertilizer to use when it can be obtained. Nitrogen is furnished by legumes. Other important sources of nitrogen are cottonseed meal and nitrate of soda. Muriate of potash is one of the potassium fertilizers. Bone meal and rock phosphate are added to furnish phosphorus to the soil.

Lime is used as a fertilizer on some soils, but more often it is used to sweeten sour soils. An acid, or sour, condition of the soil is unfavorable to crops, and therefore this action of lime in destroying soil acidity is extremely important to the farmer.

EXERCISES

1. Make a collection of soils, classifying them in the various groups to which they belong.

2. Examine samples of soils with a low-power microscope to detect, if possible, remnants of partially decomposed plants.

3. Fill a glass tube 20 inches long and one inch in diameter with air-dry sand, another with clay, and a third with loam, after inserting a cotton plug in the lower end of each tube. Now set these tubes in a pan of water and note the rapidity with which the water rises in each tube. This upward movement of water is due to capillarity.

4. Fill one of the tubes used in the previous experiment half full of sandy soil; one, half full of clay soil; and the last, half full of loam. Now place in one a handful of coarse lumps, in another a pinch of dry grass, and in the third some coarse straw; then fill each tube to the top with the sort of soil used in the lower half. Set the tubes in the pan of water used in the previous experiment. Does the water rise above the lumps, grass, or straw? Why not? What does this teach about plowing, disking, harrowing, and maintaining a soil mulch to prevent evaporation?

5. Insert a glass tumbler over a small growing plant. Drops of water soon appear on the inner surface of the glass. Where does this water come from? What does it teach?

HOME PROJECTS

1. Make a collection of as many kinds of soil as can be found on the home farm or in the neighborhood.

2. Make a map of the home farm and show by means of colors the distribution of the various kinds of soil found thereon.

CHAPTER II

CORN

History. — The importance of this cereal rightfully gives it first place in the consideration of farm crops. No other single forage plant has exerted so beneficial an influence on American agriculture and no other plant is of greater intrinsic value. While authors differ as to the original home of the corn plant, yet there is little doubt that it is of American origin.

Columbus found corn growing on the islands that he discovered on his first voyage to America, and later other explorers found it on the mainland. The Indians used it as a food; and samp, succotash, and parched corn have been handed down to present times. Corn, cultivated by the colonists, followed the early settlers westward and played an important part in our rapid agricultural development.

Classification. — Corn belongs to the grass family and to that division known as *Zea mays*. The small grains, rye, wheat, barley, and oats, in European and Asiatic countries were known as corn; and Columbus, to distinguish corn from the grains of Europe, called it Indian corn, a name that is still applied to it in some sections of the country. However, it is generally known as corn. The corn family is divided into six different groups: pod corn, soft corn, pop corn, sweet corn, flint corn, and dent corn. The first group is of no commercial importance and is

occasionally found in cornfields as a reminder of the tendency of corn to revert to its original type. In the pod corn each kernel is inclosed in a separate husk. These kernels and husks are arranged in regular rows upon the cob, similar to our dent corn.

Soft corn is grown to some extent in the South, in Mexico, and in some of the Central American States. It is charac-

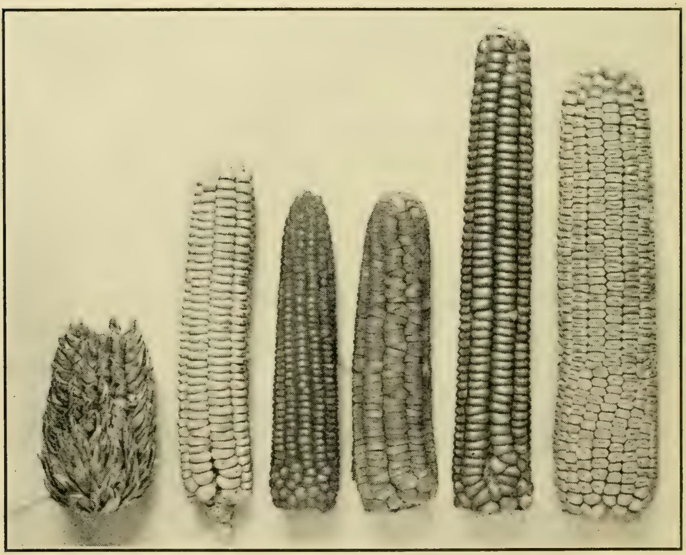

Fig. 4. — Types or breeds of corn. From left to right, pod corn, soft corn, pop corn, sweet corn, flint corn, dent corn.

terized by its high starch content and is of little commercial value.

Pop corn is grown largely as a confectionery and is handled principally by candy stores and pop-corn venders. It derives its name from its power to invert or "pop" when the moisture inclosed by the hard flinty endosperm

is subjected to high temperature. Gardeners and some farmers raise large quantities of pop corn for the confectionery market. The two chief varieties of pop corn are the rice and the pearl with many variations in each. The rice pop corn has sharp pointed kernels while the kernels in the pearl have rounded crowns resembling the flint corn.

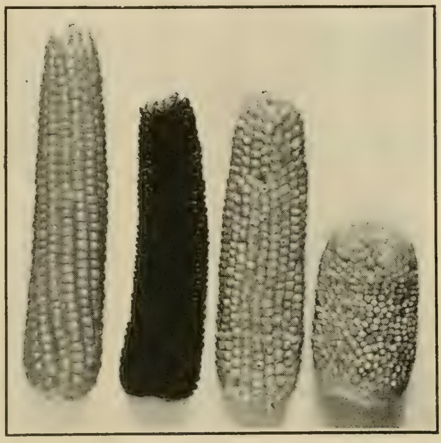

Fig. 5. — Varieties of pop corn.

Sweet corn is grown quite largely as a green vegetable and for canning purposes. Many factories throughout the corn belt make a specialty of canning sweet corn. Sweet corn is also used for feeding dairy cattle during the early part of the summer when feed is short. It is cut when the ears are soft and the whole plant is fed. There are many varieties of sweet corn, varying in color from white to black. There are early, medium, and late maturing varieties. Consequently good, palatable sweet corn can be secured through the larger portion of the summer and fall. Among the leading varieties are Stowell's Evergreen, Burpee's Golden Bantam, Early Black Mexican, Early Champion, Crosby's, and Country Gentleman.

Flint corn or Yankee corn is grown quite extensively in the New England States and in those states where the seasons are too short for the larger dent varieties. The

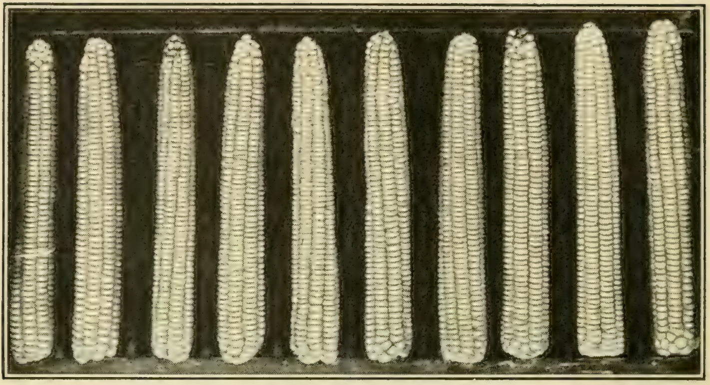

Fig. 6. — A sample of eight-row flint corn.

flint corn often gives yields comparable with the dent and is high in feeding value. This corn is readily recognized by the smooth flinty surface of the kernels. Many of the flint varieties have but eight rows to the ear; some have twelve, and fourteen rows are quite common. Some of the leading varieties of flint corn are Yellow Flint, White Flint, Red Flint, Blue Flint, Smut Nose Flint, Sanford's Flint, and King Philip Flint.

Dent corn is so called on account of the dent in the

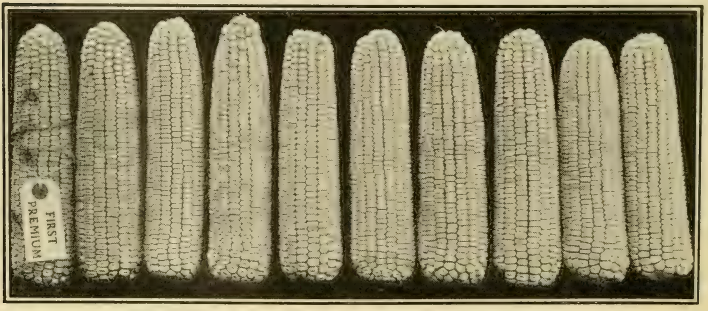

Fig. 7. — A sample of Wisconsin No. 7 dent corn.

crown of each kernel. The dent varieties far exceed in value all other groups of corn combined. There are several hundred varieties of dent corn, all of which are subdivisions of Yellow Dent, White Dent, Red Dent, and Strawberry Dent. Many of the experiment stations are now breeding high yielding strains of corn that are usually referred to by number, as Minnesota No. 13 and Wisconsin No. 7. Occasionally both name and number are given, as Golden Glow, Wisconsin No. 12. Of the white, Boone County White,

Fig. 8. — Well-developed leaf surface of special bred silage corn.

Johnson County White, White Superior, Silver King, and Silver Mine are leaders.

Habits of Growth. — The kernel of corn sends up but a single main stalk. This main stalk may branch near the surface of the ground in shoots, known as suckers, but usually only one stalk puts forth from each seed. If corn

is planted under abnormal conditions on very poor or on very rich soil, it will have a tendency to sucker. Where corn is used exclusively as a forage, suckering is not regarded as objectionable. The tendency to sucker is most characteristic of flint corn.

Corn has two sets of roots: those underneath the surface of the ground, known as feeders; and those attached to the corn plant above the surface of the ground, known as brace roots. These brace roots aid in keeping the stalk erect and in preventing the plant from being blown over or broken

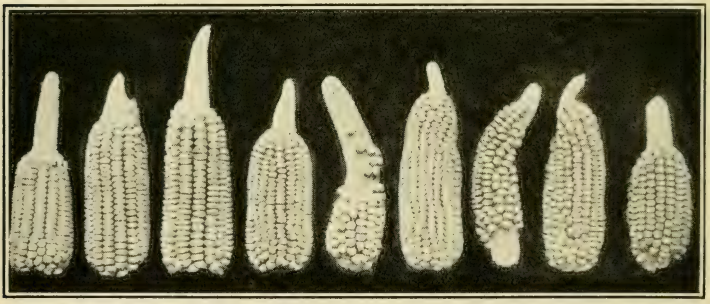

Fig. 9. — Imperfect fertilization of corn.

down during severe wind storms. The cornstalk is supplied with joints or nodes from which leaves are sent out. The number of leaves on a stalk varies from ten to twenty or more. The entire leaf surface of a single plant may be equal to twenty-four square feet. The leaf surface plays an important part in the life functions of the plant, and through the tiny respiratory openings of the leaf it is enabled to take in carbon dioxide from the air and to give off soil moisture in which the food for the plant has been absorbed. The plant is able partially to control the loss of moisture in dry spells by the closing of the transpiration organs.

The plant is also able to prevent injury to its leaves by taking on that noticeably wavy form which gives them elasticity.

Pollination. — The blossom of corn is imperfect. Its staminate or male flower is borne on the tassel, and its pistillate flowers, known as the silks, on the ears. There are a sufficient number of silks so that if each is pollinated and produces a kernel of corn, a perfect ear is formed.

A single tassel is able to shed eighteen million pollen grains, consequently great clouds of pollen are spread over cornfields during the blossoming season. The vast amount of pollen grains present in a field of corn renders it possible for each silk to be fertilized and produce a kernel. The silks at the butt of the ear come forth first, and those up through the center of the ear follow toward the tip. If a very dry or a very wet spell comes during the early part of the pollinating season, the butt silks will not be perfectly pollinated, and if the dry or wet spell comes during the latter part of the season the tip silks will not be properly fertilized, and defective ears will result. (See Fig. 9.)

Pollen grains may be carried from a fourth to a half mile by a strong wind and often a field of choice corn may be crossed by an inferior variety grown in a neighboring field. In order to keep the variety of corn pure it is necessary to plant it a safe distance from other fields. If a small grove or a hill lies between the fields, there is little danger of crossing. The prevailing wind blows quite steadily from one direction during the pollinating season and if one variety of corn is planted on the side of the field next to the prevailing wind, little crossing will occur from the pollen of other corn growing in the same field.

Uses of Corn. — Corn is used chiefly as a stock food, but in recent years an increasing amount is used as a human diet. Many of the breakfast foods are made from corn.

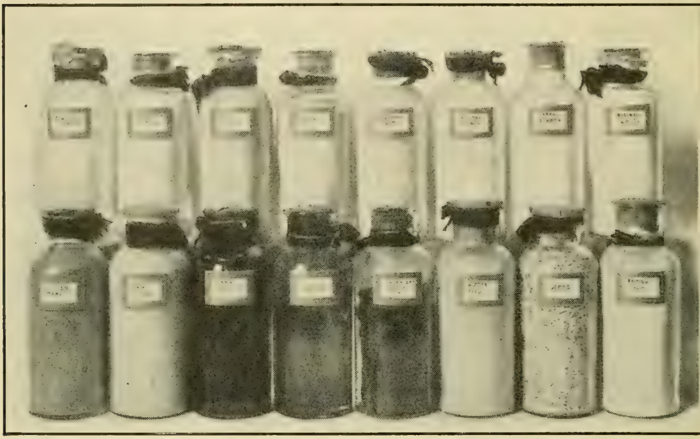

Fig. 10. — Samples of various kinds of corn products.

Fine grades of oil, sirup, sugar, and starch are manufactured from corn. Large amounts of corn products are annually shipped abroad. Glucose factories use annually many million bushels of corn for making corn products.

Corn Culture. — The seed bed for corn should be carefully prepared before the seed is planted. It is better to plow clay soil in the fall and let it lie in the rough through the winter. The frequent freezing and thawing of the ground allows the lumps to break down easily and the land by proper cultivation in the spring can be put into good tilth. If clay lands are plowed in the spring, they should not be plowed deeper than in previous years. New ground brought to the surface in the spring is detrimental to the corn crop.

On sandy lands and on river bottoms, subject to spring overflows, it is preferable to plow in the spring. Whichever practice is followed the fall-plowed land should be disked in the spring as soon as it will work well, and the disk followed with a fine-tooth harrow at weekly intervals to sprout weed seeds and to retain soil moisture by stirring the surface to prevent the loss of water from the soil. If this is not done, the ground will dry out rapidly and the surface soil will be cool as long as rapid evaporation is going on. Land becomes mellow if worked early in the spring, and retains that mellowness throughout the season.

If land is plowed in the spring, it should be dragged the same day except in damp weather, when it can wait until the next day. It is injurious to the ground to let it bake

Fig. 11. — A corn planter.

in the spring after the furrow is turned, for when it is once baked it cannot be brought into good tilth again that year. When land is plowed in the fall it should lie in the rough during the winter.

Testing the Planter. — The corn should be run through a corn grader before planting, or ears having the same width of kernels should be selected before shelling so that the planter can handle the kernels in a uniform manner. The planter should be tested in order to secure the proper planter plate to drop the desired number of kernels to the hill. In the Northern States the aim is to get 4 kernels

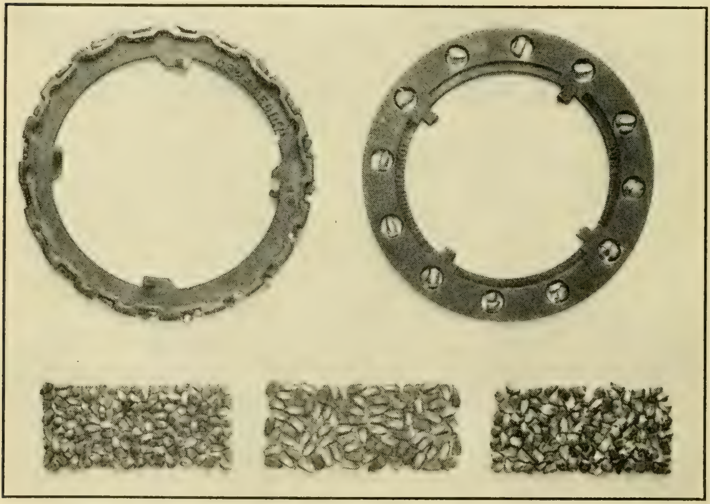

Fig. 12. — Above, two types of planter plates. Below, uniform kernels of corn at left; irregular tipped kernels in the middle; irregular butt kernels at right.

in each hill. Farther south 3 kernels are preferred. If 3 kernels are placed in a hill, and the hills are placed $3\frac{1}{2}$ feet apart, there will be 10,668 stalks per acre if each kernel grows and produces a plant.

The butt and tip kernels should be rejected from the ears as they are not regular in size and do not germinate uniformly. Corn cannot be planted evenly if the butt and

tip kernels are left in the seed corn. Corn is planted either by drill or by the check-row method. On mellow land there does not seem to be much difference in yield by each method if the same number of stalks are grown per acre, but on the heavy or weedy soils the check-row system is preferable as it allows cross cultivation, which keeps the land mellow and kills the weeds close to the hills. Corn should be planted after the ground has lost its winter chill and the chances of heavy frost are past. The larger portion of the corn crop of the United States is planted in May and harvested in September and October.

Fig. 13. — First cultivation of corn.

Cultivation. — Immediately after planting, a fine-tooth harrow should be run over the ground to level it and to kill additional weeds. As soon as the corn is noticeably above the ground it should be cultivated at a fairly good depth. The subsequent cultivations should be shallow, as the roots of the corn soon push out to the center of the row and will be severely injured if deep cultivation is practiced. Cultivation should be continued until the corn shades the ground. If subsequent heavy rains occur, it is often good practice to go through the corn with a one-horse cultivator and break up the crust that has been formed by the rains.

Harvesting. — Corn may be cut by hand, with a corn knife, or harvested with the corn binder. The binder is a machine that binds the cornstalks as it cuts them, thus making the crop easy to handle. The bundles are shocked and later drawn to the barn and run through a shredder; or the ear corn is husked in the field and drawn to the cribs and the stalks stored away for feed. Cornstalks, after the ear corn has been removed, are called stover. If used for feed when the ears are not removed, they are called fodder corn.

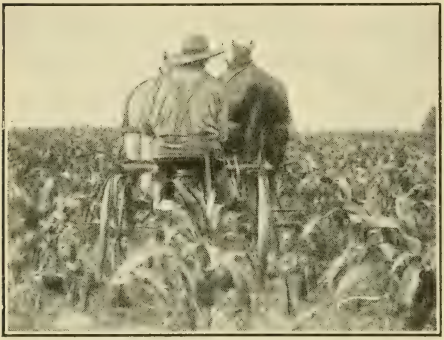

Fig. 14. — Last cultivation of corn.

Fig. 15. — A corn harvester.

In some sections of our country the corn is merely taken from the standing stalk and the stalks are left in the field. Since approximately one third of the feeding value of corn

is in the stalk, this manner of harvesting corn should be discouraged.

Corn is often cut, shocked, hauled to the barn when needed, and run through the feed cutter so as to put it in convenient form for feeding. In other instances it is fed whole with ear and stalk. One of the most convenient ways of saving a large quantity of forage for farm stock is in the form of silage. The corn is harvested at the time when the kernels are glazed and some of the lower leaves have turned brown. At this particular stage the highest feeding value can be obtained from the corn.

Fig. 16. — Filling a silo.

Silage corn is drawn directly from the field and run through the feed cutter set to cut about an inch in length. It is put into the silo by elevator or blower and firmly packed to exclude air. If the corn is somewhat dry when run into the silo, water should be used to moisten it.

Silage will keep for a year or more and is greatly relished by all farm animals, especially dairy cows. Siloing corn is the most economical way of putting up large quantities of

feed. Several different makes of silos are used, all of which have their special merits.

Testing Seed Corn. — An increased yield of corn can be secured by testing each ear before planting, and rejecting those ears that do not germinate or that show lack of vigor or vitality. It is not a difficult task to test each ear of seed corn. Fifteen average ears of corn will plant one acre, using 4 kernels to the hill and placing the rows $3\frac{1}{2}$ feet apart. When the importance of testing seed corn is fully realized, few farmers will plant corn without first submitting it to the test.

Selecting Ears for Testing. — Only the most nearly perfect seed ears, having kernels of a uniform width, should be saved for seed. These should be selected from the storeroom and laid out on the floors or on tables to be convenient for making the test. Care should be taken to place the ears where they will not be disturbed during the test. The ears should be arranged in groups of ten, so as to correspond with the sections in the seed tester. Each individual ear of each section should be numbered. At least 4 kernels, sometimes 6, are taken singly from different parts of each ear and placed directly in front of the ear from which they were taken.

Seed Corn Tester. — For testing large quantities of seed the common square box tester is preferable. For a limited number of ears the pie plate test, in which moistened cloth pads or blotters are used between plates, is reliable. Cotton cloth folded into several layers and moistened makes a good device for testing small quantities of seed corn. Small squares in which to put the kernels from the different ears should be indicated on the cloth and the cloth then rolled so as to retain the moisture.

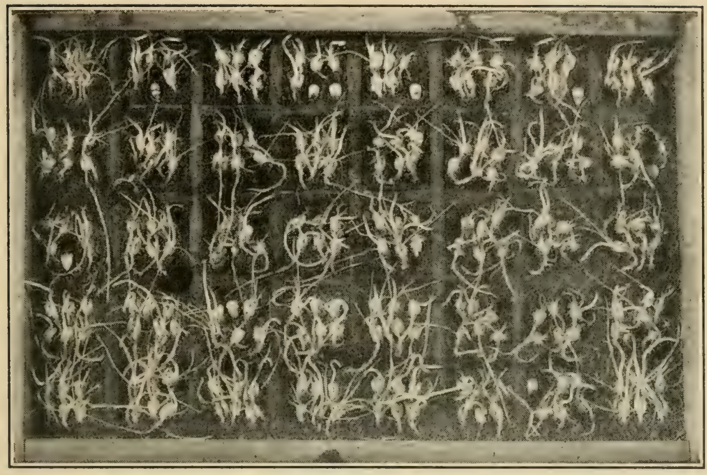

Fig. 17. - A seed tester, showing that most of the grains have vigorous sprouts, that a few have weak sprouts, and that some have not germinated.

A suitable box for making germination tests can be made from common boards. A convenient size is 20 × 40 inches, and 6 inches in depth. Sawdust is an excellent material to use as a germination bed but it should first be put in a sack and boiled in water in order to kill bacteria and molds. The sawdust should be placed in the box about 3 inches deep and should be kept moist but not wet.

A piece of good muslin upon which two-inch squares have been marked and numbered to correspond with the ears to be tested, is pulled tightly over the sawdust and tacked securely to the sides of the box. The kernels of corn taken from ear No. 1 are put into square No. 1, and from ear No. 2, into square No. 2, and so on until all are used. A moistened cloth is placed over the kernels and a muslin sack about two inches thick partially filled with sawdust is placed on top of the cloth.

The tester should then be placed where it will be held at ordinary room temperature or a little warmer. During the day the sawdust reaches a temperature which it holds during the night. Even though the outside temperature drops several degrees that of the germination bed will be fairly constant. Usually it requires from five to six days to make a good test. If at the end of three days the pad of sawdust is dry, it should be moistened again.

Checking the Results of Tests. — After five or six days have elapsed the sawdust pack should be taken off and the cloth rolled back, care being taken not to move the kernels out of their respective squares. The kernels should be inspected first to note if any have absolutely failed, second, if each kernel has put forth both root and growing point, and third, the vigor or vitality shown in the germination.

All ears having kernels that show defective germination should be moved forward on the table. After the test has been thoroughly checked up, all the ears that were moved forward are rejected and the others used as seed. Before shelling the seed, the butt and tip kernels are removed as these lack uniformity in size and shape and do not give uniform germination. If the butt and tip kernels are used at all, they should be planted by themselves.

Curing Seed Corn. — One of the factors that enter into the securing of higher yields of corn is the curing of the ears. It is just as easy to cure corn in a proper manner as it is to store it away on the barn floor or in an exposed crib, where it will mold or be destroyed by rats and mice.

The following points should be observed in selecting seed corn:

1. Seed corn should be allowed to mature well on the stalk.

2. For corn-breeding work the ears should be selected from promising plants, which should be marked and the ears left to ripen.

3. Mark only stalks that are leafy, of medium size, and carrying one good ear to the plant.

4. Select only well-formed ears.

Fig. 18. — Selecting seed ears from desirable plants.

The common practice of selecting the earliest maturing ears and picking them from the stalk as soon as the husks begin to turn yellow secures earliness at the expense of vitality. A slight frost will not injure corn if it is well matured, and it is better to run the risk of frost than to pick the ears too early. The latter part of the growing season seems to improve greatly the vitality of the corn.

Care should be taken in the picking of seed to secure ears that are attached to the stalk about 3 or 4 feet above the ground. The ears that grow either very high or very low upon the stalk should be rejected as undesirable. For the same reason we should avoid selecting ears with very short or very long shanks and also those from deformed stalks.

Select the well-formed ears after the husks have turned yellow. It is well to follow definite rows in securing seed corn, otherwise large numbers of good ears are missed. If the corn plants have been studied at a time when the corn is in the milk, the desirable stalks marked, and the ears selected from these marked stalks after ripening, a higher grade of seed corn can be secured than by general selection. After the corn is husked, many ears will be found imperfect and should be discarded. Seed corn should be put into the proper place for curing on the same day it is taken from the field.

When taken from the stalk, corn usually contains from 20 to 30 per cent of moisture, which, unless reduced to 10 or 12 per cent, is likely to injure the quality of the seed.

If the corn is cured by hanging under a porch or under the roof of a corncrib, it should be stored away in a dry room, where it will not absorb moisture from the outside atmosphere before hard freezing weather sets in. Germination tests have shown that where corn was kept in a dry room or attic or was fire-dried it gave a germination test of 98 to 100 per cent, but where left shocked in the field or on the standing stalk throughout the winter, it completely failed to germinate.

Corn should never be placed against the south side of a building in the strong sunlight, as the rays of the sun will soon injure the vitality of the seed on the side of the ear turned toward the sun.

During exceptional years when the corn matures well in the fall before cold weather sets in, it will withstand freezing and retain its vitality on the stalks or in open cribs fairly well, but in most years the vitality of the corn will be materially reduced and the germination will be

exceedingly low at the time of planting, if left exposed to the weather.

In the Northern States where the seasons are short, the most convenient way of ridding the corn of excessive

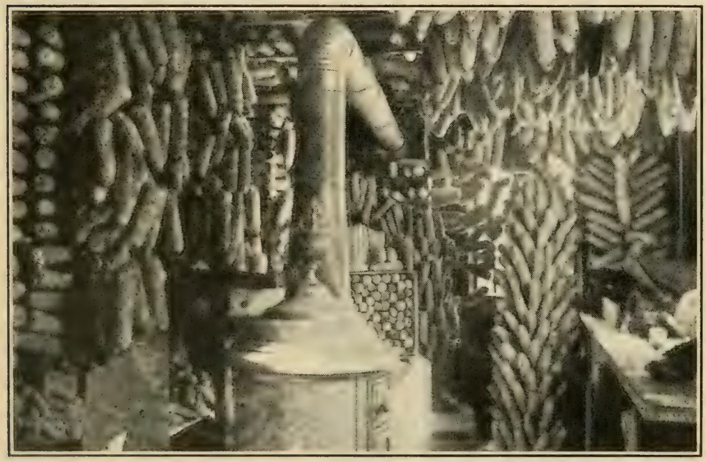

Fig. 19. — Curing seed corn with artificial heat. Note the various arrangements of the ears of corn.

moisture is by the use of artificial heat. This method is known as curing, kiln-drying, or fire-drying and may be done as described below. By thoroughly kiln-drying seed and properly storing it thereafter, the corn yield can be materially increased over that which could be secured from seed not subjected to this drying process.

Where kitchen or furnace room can be used for curing corn, simple devices may be used for holding the corn. A practical method is to tie the ears so they are a safe distance apart for drying. Another method is to use double cord, placing ears between them so that they can be held securely and hung on a nail or hook by the loop. Two

persons can conveniently put up a large quantity of corn in a short time by the use of the double cord. One person holds the cord while the other places the ears in position as shown in Fig. 20.

Small movable racks are often used in which sufficient corn to plant five or six acres can be placed and the racks put up in the house until the corn is well dried. Another device is the "corn tree," shown at the right of Fig. 19, which is convenient for curing small quantities of seed corn. Often this device can be placed in a doorway or window where there is a strong current of air to help carry off moisture. Such a tree 6 feet high will hold enough corn to plant 15 acres.

Fig. 20. — Method of arranging corn in the double cord hanger. One person holds the cord while another places the ears in position.

Boards fastened together in panels and finishing nails driven in on both sides at the proper distance apart so that the ears will not touch make a good corn-curing device. By having the panels fastened about two feet apart at top and bottom a large quantity of corn can be stored conveniently and in such a way as to permit free circulation of air.

A ventilated attic that has a chimney passing through it or is located directly over a heated room so that it can be kept at a fairly uniform temperature through the winter is a very good place to cure corn. The attic is usually the driest portion of the house and if corn is stored in it in racks or hanging devices in the early fall, it will cure exceptionally well. During the warm fall weather the attic is usually heated by the rays of sun on the roof to a fairly high temperature and the effect upon the corn is the same as that of fire-drying, provided the quantity of corn is limited. If a large quantity is to be dried within the attic, it will be necessary to set up a small stove and have plenty of ventilation in order to cure it in the best manner.

Underneath the roof of the corncrib is a good place to cure corn during the early fall. It should be hung where there is a strong circulation of air through the crib. After corn has hung there for four or five weeks, it can be taken out and put into an attic or a dry room to be kept through the winter.

EXERCISES

1. If planting corn in accordance with the check-row system, placing the hills $3\frac{1}{2}$ feet apart and dropping 3 kernels to the hill gives 10,668 plants per acre, how many bushels of corn can be grown on 120 acres if the corn after husking weighs one pound per ear and each plant produces one good ear? Estimate corn from the field at 80 pounds per bushel.

2. If the corn was fire-dried and the weight reduced 15 per cent by driving off moisture, how many bushels would there be, considering the weight of fire-dried corn in the ear at 70 pounds per bushel?

3. If $\frac{1}{5}$ of the corn is found to be sufficiently good to sell for seed corn at $2.50 per bushel, and the remainder is sold at

\$1.20 per bushel, how much money will be received for the corn?

4. If the above field was planted to a select variety of high-bred corn that gave 10 bushels more corn per acre after fire-drying and this corn was found to run $\frac{1}{3}$ seed ears, which sold at \$3.50 per bushel and the remainder at \$1.25 per bushel, how much more would be realized by growing the select variety of corn?

5. How much will it cost for seed to plant a 40-acre field, the seed being worth \$3.75 per bushel of 100 ears, if 18 ears are needed to plant one acre?

6. How many gallons of water would there be in 2000 bushels of cribbed corn, providing it contained 20 per cent moisture? Estimate the weight of corn at 80 pounds per bushel and water at one pound per pint.

7. A bin $12' \times 12' \times 10'$ will hold how many bushels of shelled corn? A bushel equals 2150.4 cubic inches.

HOME PROJECTS

1. In the fall select seed corn from foundation field for corn improvement. Go into the field when the corn has reached the milk stage and the plant shows its characteristics to best advantage. A study of the corn plant at this time by individual rows will aid materially in getting good foundation stock.

Select a plant having numerous leaves and one good ear that is attached with medium shank to the stalk. The ear should be attached between 3 and 4 feet from the ground, and the plant should look strong and vigorous.

A red string or some other mark should be attached to the plant so that it will be readily recognized after ripening. At least 200 corn plants that closely resemble each other should be marked. After the field of corn has ripened fully pick the ears from the marked stalks and husk them on the same day that the corn is picked.

Discard 50 ears that are inferior and fire-dry the remainder for seed. After fire-drying make germination test and discard 50 more ears if necessary that are not strong and vigorous in germination. Save at least 100 ears for "ear-to-the-row" test the following spring.

2. In early spring begin work on corn improvement by the ear-to-the-row method. Shell off butts and tips and save the

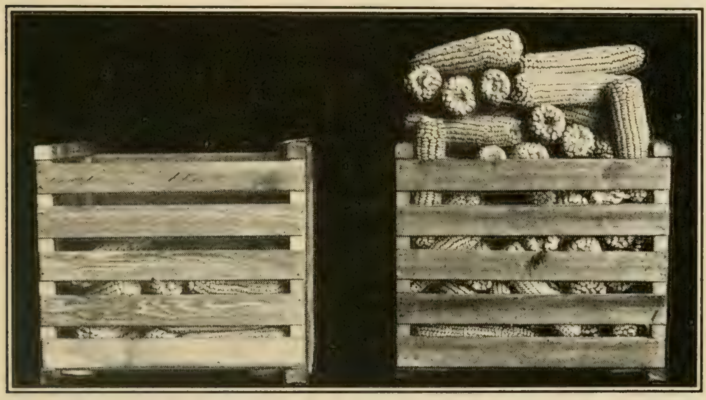

Fig. 21. — Results of the ear-to-the-row method of corn breeding. Yields of good seed corn from rows planted with seed from different ears. Crate on left has 19 pounds of seed corn; crate on right has 62 pounds of seed corn.

corn on the middle portion of the ears for planting. Select a field where the soil conditions and rotation of crops are uniform. Place hills $3\frac{1}{2}$ feet apart each way. Have the same number of hills in each row and place 3 kernels in each hill. Use only about two thirds of the kernels on each ear. After ripening, harvest each row separately and divide into seed ears, crib corn, and nubbins.

Save the seed corn for field work from those rows that throughout the growing period showed uniformity of plant growth and that gave the largest amount of good quality of seed ears. The seed from three or four of the best rows in the hundred-row test should be saved for seed.

3. Detassel corn to prevent self-fertilization. Go into the ear-to-the-row test field just at the time when the tassels are beginning to show. If the sheath which incloses the tassel is pinched several inches beneath the top of the tassel, we can readily remove the tassel from the plant by pulling it out. Every alternate row is treated in this way so that one half of the rows in the test will be detasseled and the other half will bear tassels. The tassel-bearing plants will fertilize the silks on the detasseled plants, and also those on the tasseled plants. The seed should be retained from the detasseled plants upon which a cross has been forced. If any inferior or barren plants are found in the tasseled row, pull them up or detassel.

CHAPTER III

CORN AND GRAIN JUDGING

JUDGING CORN

Judging the Basis of Corn Improvement. — For many years the score card has been used in judging live stock, butter, and cheese; but not until recently has it come into general use as an aid in judging corn and other grains. Experience has shown, that while the judging of corn by the score card is not a definite science, it gives the farmer and the student the best opportunity for estimating the value of an ear of corn. By carefully studying the different points under which corn is judged, and carefully noting the defects of each ear, one will soon become so proficient that he can select good seed corn, or act as judge satisfactorily in corn contests.

Corn may be improved by the farmer in two ways: by the selection of the best ears for seed from the best stalks in the field, or by selecting the best ears from the best row in a field, each row of which has been planted with seed from a single good ear. Such selection of seed is a simple method of corn improvement and can be practiced by any farmer.

To improve corn by seed selection it is necessary to know what kind of ears to choose for seed. For this purpose a list of the most important points has been prepared on a sheet known as a score card. Each ear is examined and compared with the standard. The score card shown in this

book has been prepared for a perfect ear of dent corn. In scoring, a cut is made in each point in which the ear being scored is inferior to the standard.

Before corn can be accurately judged, the one who scores the corn must have a mental picture of the perfect ear. By examination of good specimens, this ideal can be readily fixed in the mind, and in judging other ears the extent to which they fail to equal the ideal can be indicated on the score card. To understand best the various points of the score card they must be studied separately, in the order presented in the following paragraphs.

A sample of corn for judging or exhibition purposes should consist of ten ears of any variety. This number furnishes

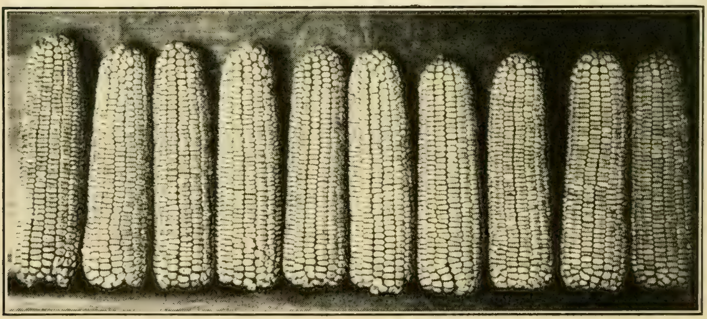

Fig. 22. — Ten uniform ears of corn. The kernels and ears are uniform in size, color, and general appearance.

an easy basis for calculating the cuts for various defects, and a sufficient number of ears for a fair sample.

Arranging the Sample. — Arrange the ears in the sample so that the one considered as the best ear is on the left, the next best second, and so on, the poorest ear being the last on the right. Also keep uniformity in mind. Have ears of nearly the same size together. Do not have a short

ear and a long one side by side. Sometimes it is necessary to put an ear out of its place in the order of excellence to preserve uniformity in the sample.

WISCONSIN OFFICIAL CORN SCORE CARD

	Perfect Score	Score of Sample	
1. Trueness to type or breed characteristics	10	6	0
2. Shape of ear	10	6	5
3. Color: *a.* Grain	5	3	8
b. Cob	5	3	7
4. Market condition	10	7	5
5. Tips	5	3	5
6. Butts	5	2	5
7. Kernels: *a.* Uniformity of	10	7	0
b. Shape of	5	3	7
8. Length of ear	10	7	8
9. Circumference of ear	5	3	5
10. Space: *a.* Furrow between rows	5	3	0
b. Space between kernels at cob .	5	3	5
11. Percentage of corn	10	7	5
Total	100	69	5
Cuts for general defects		5	0
Final score		64	5

Name. . . . .

Sample No. . . . .

How the Sample is Scored. — After the sample is arranged, each ear is scored for the various points in order.

The following example, showing how a sample is scored for trueness to type, will serve as an illustration.

In judging trueness to type, a general study of the ear is made. Under this head the ear is criticized only from the general standpoint of type factors, and no numerical score is given for other points in which the ear is deficient. Suppose ear No. 1 has the shape, size, and color of the breed of corn it represents but is not quite perfect. The color of grain may be slightly off, a few kernels may be off type, or the shape may not conform to the breed. This ear is not quite perfect from the standpoint of trueness to type. It may be cut .2 point under that head.

Ear No. 2 is a fairly good ear, but has a few more defects than ear No. 1. On the points under consideration it is poorer than ear No. 1 and would be cut .3 of a point.

The same method is followed with all the ears. Each ear is criticized and a general cut is made. Then the sum of all the cuts is deducted from the total ten points for a perfect score, and the remainder is the rating given the sample on trueness to type. For example suppose that our cuts on the ten ears are as follows:

Ear No. 1	.2
Ear No. 2	.3
Ear No. 3	.4
Ear No. 4	.25
Ear No. 5	.35
Ear No. 6	.2
Ear No. 7	.25
Ear No. 8	.15
Ear No. 9	.5
Ear No. 10	.4
Total	3.00

The 3 points are deducted from the perfect score of 10, leaving 7 points as the score for trueness to type.

The same method of cutting is used on all points except

the percentage of corn to cob, and the length and the circumference of ear, which are determined by actual weight and measurement.

After the student has had several exercises on scoring single ears in a sample he is then required to score the sample as a whole, using the ten ears as a unit. He will make cuts on the entire sample of ten ears similar to the method employed with the single ear. Instead of adding the exact score of the ten ears separately under the various heads, as given in the illustration, he scans the entire ten ears closely and puts down his estimated score for the whole ten ears. By the use of the decimal notation, instead of common fractions, the method is very much simplified.

Suppose that a student, judging a sample for trueness to type, finds sufficient defects to cut four points, he then deducts this from the perfect score, and enters the number, 6, in the proper column on the score card. He then continues the examination of the sample under the various headings, and enters the score on each point as indicated on the score card.

Adding the score under each head gives the total score of the sample. If the sample shows a pronounced general weakness, points should now be deducted for general defects, as explained later. In the score card on page 42 the total score is 69.5. The sample is cut 5 points for general defects, and the final score is 64.5.

POINTS UNDER WHICH CORN IS SCORED

Below are discussed each of the separate points under which corn is scored, the perfect score for the point under consideration is stated, and directions for judging and rules for scoring are given.

TRUENESS TO TYPE OR BREED

Perfect Score. — The corn should conform to the standard for the type and breed in form of kernel, shape of ear, indentation, and color of grain. Perfect score, 10 points.

Directions for Judging. — The first point in judging a sample of corn is to determine its trueness to the type or breed characteristics. There are breeds of corn, like breeds of cattle, having peculiar colors or forms which distinguish them; as, for example, the Silver King is a white variety and the Golden Glow a yellow variety. It is difficult to distinguish between breeds of the same color, but this may be learned by experience in handling corn of different breeds. In pure corn of any breed there are certain marks which can be easily recognized.

Rule for Scoring. — Deduct one point for each ear which differs radically from the type, and less for each ear that is partially off type.

SHAPE OF EAR

Perfect Score. — The ideal ear is cylindrical, conforming to the standard for the variety, not crooked nor tapering. Perfect score, 10 points.

Directions for Judging. — It is as difficult to find an ear of corn perfect in shape as it is to find cows, horses, and sheep with perfect forms. The shapes of ears of the different varieties of corn differ as widely as the shape and form of the different pure breeds of cattle. Each class and variety has a characteristic shape peculiar to itself. For example, Silver King corn has an ear of medium length, large in circumference; while the Golden Glow has an ear considerably shorter and finer in cob and general conformation.

The most desirable shape ear is cylindrical from butt to

tip. Where ears are inclined to taper, it will be noticed that two or four rows, as a rule, are dropped near the middle of the ear. In scoring corn, take into consideration the soil and climatic conditions in which the corn was grown. The shape of a desirable ear for central Illinois differs in many respects from the shape most desirable for Wisconsin. The shorter growing season in Wisconsin demands a shallower kernel and a smaller ear to enable the corn to mature in a short season.

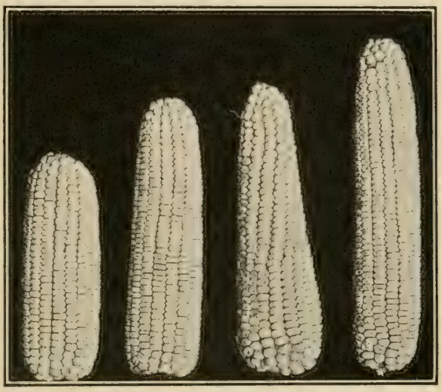

Fig. 23. — Ears of desirable and undesirable shape. The ear at the left is too short and thick, although good in other respects; the second is desirable; the third has an enlarged butt and irregular rows; the fourth, at the right, is too slender.

Rule for Scoring. — No rule can be given as to the exact number of points to be cut on account of defects in shape. In general, cut one point for each poorly shaped ear.

COLOR OF GRAIN AND COB

Perfect Score. — The color of the grain should be uniform and true to the color standard for the variety, free from missing or discolored kernels. Perfect score, 5 points. The color of the cob should be a bright cherry red for yellow corn and glistening white for white corn. Perfect score, 5 points.

Directions for Judging. — The color of the corn varies with the breed. The Silver King corn has a cream color,

while the Boone County White has a pearly white color. These shades have become characteristic of the breeds. Yellow breeds vary slightly in color from a pale yellow to a deep orange, and the correct color can only be known by a thorough acquaintance with the variety.

If the cobs vary from the standard, a cut should be made by the scorer. A bright cherry red denotes health and vigor in corn and a pale or dark red cob denotes lack of constitution or vitality. The white corn cobs should be a glistening white and not a pale dead color.

Some farmers prefer to grow corn of a certain color. From tests made by breeders of corn, and by experiment stations, it has been found that in general, color makes no difference so far as feeding value is concerned. Starting with white and yellow corn of equal merit, careful breeding of one variety and neglect of the other would soon produce a marked difference in the yield and quality in favor of the variety to which the best attention had been given, regardless of the color. Like the breeder of live stock, the corn grower should select that breed of corn which suits his taste best, keeping in mind that the quantity and quality of marketable corn per acre are the essential characteristics sought for.

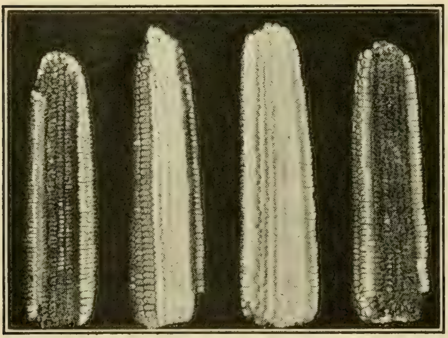

Fig. 24. — Desirable and undesirable cobs. The yellow corn with a red cob, at the left, is desirable; the second, yellow corn with a white cob, should be scored off sharply; the third, white corn with a white cob, is ideal; the fourth, white corn with a red cob, denotes mixture.

Rule for Scoring. — For each mixed kernel on an ear a cut of .1 of a point should be made to the extent of .5 of a point for the ear. Kernels missing from the ear are counted as mixed. Difference in shade or color, as light or dark red, white or cream color, must be scored according to variety characteristics. A white cob with yellow corn, or a red cob with white corn, should be cut .5 of a point.

MARKET CONDITION

Perfect Score. — Corn should be ripe, sound, free from injuries or disease, and bright in color. Perfect score, 10 points.

Directions for Judging. — By market condition we mean general excellence and the degree of ripeness or maturity. Corn that shows a tendency to be loose on the cob with wide spaces between the kernels should be scored off heavily. Where market condition is perfect or nearly so, the kernels are firm on the cob, they fit closely together on the cob and in the row, and the ear gives a rasping sound when twisted.

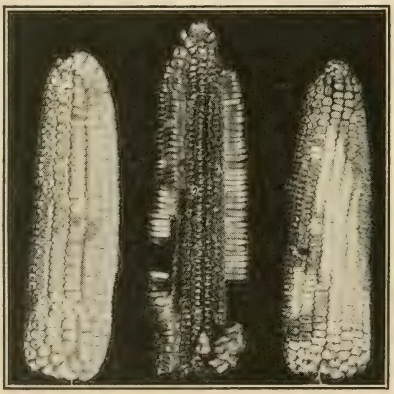

Fig. 25. — Ears showing poor market conditions. The ear at the left is moldy and soft; the middle ear is immature, loose on the cob, and badly shelled off; the third is mouse eaten.

When corn is scored from the feeder's standpoint it is not cut so severely as from the grower's or seedsman's standpoint.

No other head under which corn is judged is so important

to farmers as market condition, and all farmers should be able to judge corn for the perfection of that characteristic. The utmost importance is attached to market condition in carrying on variety tests, as a variety of corn is of little value to a community, if it does not properly mature within the growing season. However, corn will gradually adjust itself to varying conditions of soil and climate; and the earliness of corn can be improved materially by selecting those ears for seed that show good market condition, even if there are but few in the entire field.

Rule for Scoring. — Cut up to one point for every diseased, chaffy, injured, or immature ear.

TIPS AND BUTTS

Perfect Score. — (*a*) Tips. The kernels should extend over the tip in regular rows, and be uniform in size and shape. Perfect score, 5 points. (*b*) Butts. The kernels should extend over the butt in regular rows and be well developed and uniform. Perfect score, 5 points.

Directions for Judging. — A perfect tip has a central kernel called the cap, which is completely surrounded with uniform kernels. A perfect tip is rarely found, but those which come nearest to the ideal should be chosen, providing it is not at the expense of other more important factors. The tip kernels are likely to be flinty and of a pop-corn shape, which is undesirable in dent corn. If bare tips are noticeable generally throughout the field, it may be due to the fact that the silks representing the tip kernels which were formed last were too late to receive the pollen for their proper fertilization. If ears having defective tips or butts are used for seed, their undesirable characters will soon become permanent. Open tips usually accompany

shallow and irregular kernels on the ear, which makes the kernels on that part of the ear undesirable for planting.

In judging the character of the butt of an ear of corn, the way in which the rows come over towards the shank is

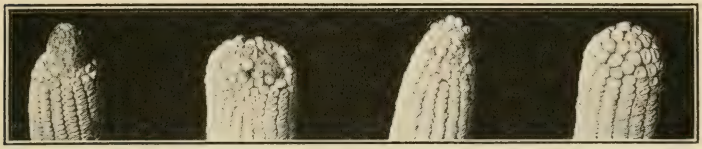

Fig. 26. — Desirable and undesirable tips. The three tips, beginning at the left, are undesirable; the one at the right is almost perfect. The first one at the left has a bare cob; the second is double tipped; and the third is too pointed.

important. If the corn comes in too close, it reduces the size of the shank where it is attached to the ear, and causes the ears to drop off during the ripening period. Corn breeders in desiring to get a large proportion of corn to the cob, often choose ears with too small an attachment for the shank. All ears that have butts improperly filled should be rejected. The butt and the tip kernels are rejected for planting, because they are more likely to be mixed with other varieties, and since, due to their peculiar round forma-

Fig. 27. — Butts of corn ears — four kinds. The one at the left is well formed, the next is too contracted; the third too flat, and that at the right is badly formed and poorly filled out.

tion, they interfere in the planting. They also are weaker in germination and vary more in growth than kernels from the middle parts of the ear.

No planter plate can handle butt and tip kernels so as to

drop a uniform number of kernels per hill. As is shown in the illustration on page 26 both the round hole drop planter plate on the right and the edge drop plate on the left are so constructed as to hold one middle kernel for each hole or notch. In case the tip and butt kernels are mixed with the middle kernels, it is possible, as shown above, for two or three of these irregularly shaped tip and butt kernels, or for a large middle and a small tip kernel to fit on one hole or notch. This will cause irregularity in the number of kernels planted per hill.

Rule for Scoring. — The tips and butts that do not meet the standard should be scored severely. Where one inch of cob is exposed at the tip a cut of one point should be made. Regularity of rows near the tip and the shape and size of the kernel must also be considered. If the kernels on the butt are uniform in size and extend around it in regular order, give it a full score. Cut in proportion as the grain is small or compressed.

KERNELS

Perfect Score. — (*a*) UNIFORMITY. The kernels should be alike in size, shape, color, and true to the type or variety. Perfect score, 10 points. (*b*) SHAPE. Kernels should be of wedge shape, the width at the tip depending on the variety characteristics. Perfect score, 5 points.

Directions for Judging. — The crown or big end of the kernel should be such that the edges of the kernels slope from tip to crown. The tip of the kernel, which is the part attached to the cob, contains the larger portion of the germ and is rich in protein and oil, and consequently of the highest feeding value. A plump tip and wide germ usually indicate strong vitality.

Remove two typical kernels from each ear and place them above the ear to which they belong. These kernels are the ones compared in determining shape and uniformity for the sample. The uniformity and shape of the kernels on the individual ear are also considered.

Kernels with weak or shriveled tips should be discarded, no matter how well the outside of the ear may look. At least

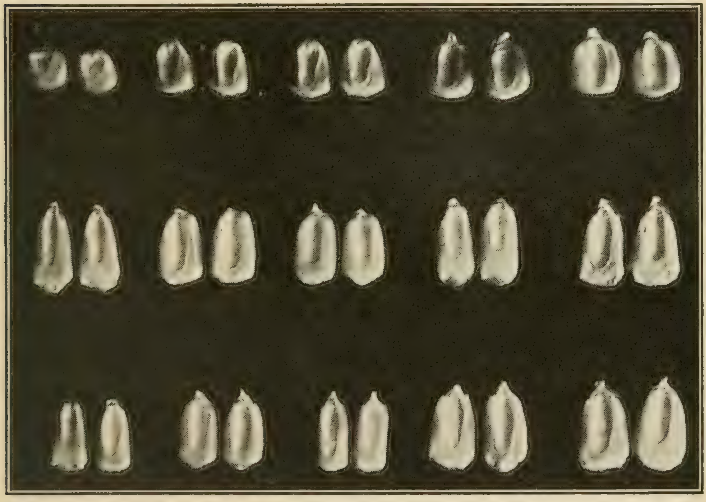

Fig. 28. — Various shapes of kernels. To judge kernels remove two kernels from each ear two thirds of the way from butt to tip. Place each pair near the ear from which they were taken and compare with the ideal. The top row here shown illustrates the best, while those in the bottom row are too short and thick for dent corn. The long wedge-shaped kernels shown at the right of the top row and the pair in the center of the top row are most desirable.

85 per cent of the oil in the kernel is in the germ, hence corn with well-formed germs is desirable. Tests show that the oil in corn may vary from 2.5 per cent to 7.5 per cent and the protein from 6.5 per cent to 16 per cent. If seed corn contains a large amount of protein and oil, the crop grown from this seed will be high in these desirable features.

Rule for Scoring. — Cut one point for each set of kernels which are not uniform. Cut .5 of a point for each set of kernels which are shriveled or poorly formed.

LENGTH AND CIRCUMFERENCE OF EAR

Perfect Score. — (*a*) LENGTH. The ear should be up to the standard for the section in which the corn is grown. Perfect score, 10 points. (*b*) CIRCUMFERENCE. In circumference the ear should be up to the standard for the section in which the crop is grown. Perfect score, 5 points.

Fig. 29. — Relation of length of ear to circumference. The ear at the left is too short and thick; that at the right is too long and slender; the middle ear has the correct proportion of length to circumference.

Directions for Judging. — Standard measurements for corn vary with the locality in which it is grown. Long ears are objectionable because they usually have poor butts and tips, and shallow kernels, and hence a low per cent of grain to the ear In general the circumference should be three fourths of the length.

The chief reason for distinct measurements is to secure uniformity and compactness in ears. In scoring one must not accept ears that are out of the natural proportion, but must be governed by some uniform standard. In some of

the older corn-breeding states, each distinct variety of corn has its respective measurements as to length and circumference.

Rule for Scoring. — Add the deficiency and excess in inches of all ears not conforming to the standard, and for every inch thus obtained cut one point. Likewise add the deficiency and excess in circumference in inches of all ears not like the standard, and cut .5 of a point for every inch thus obtained. Suppose the length and circumference of the ten ears, compared with the standard for the variety, is as follows, the plus sign indicating that the ear has greater length or circumference than the standard.

Ear Number	Excess or Deficiency	
	In Length Inches	In Circumference Inches
1	+ 0.50	+ 0.25
2	+ 0.75	+ 0.50
3	+ 0.50	0.00
4	0.00	+ 0.10
5	0.00	0.00
6	− 0.10	0.00
7	− 0.10	− 0.10
8	− 0.25	− 0.20
9	− 0.25	− 0.10
10	− 0.50	− 0.25
	2.95	1.50

Therefore, cut the sample 2.95 points for length and .75 of a point for circumference.

SPACES BETWEEN ROWS AND KERNELS

Perfect Score. — (*a*) Furrows between rows. The furrows between rows should be straight, with uniform space between kernels at the crowns. Perfect score, 5 points.

(*b*) Space between kernels. No space should be noticeable at the tips near where they are attached to the cob. Perfect score, 5 points.

Directions for Judging. — Straight rows are the most desirable as they give a uniform appearance to the ear and admit of the kernels being placed in a more nearly exact position. The kernels on ears with spiral rows are irregular

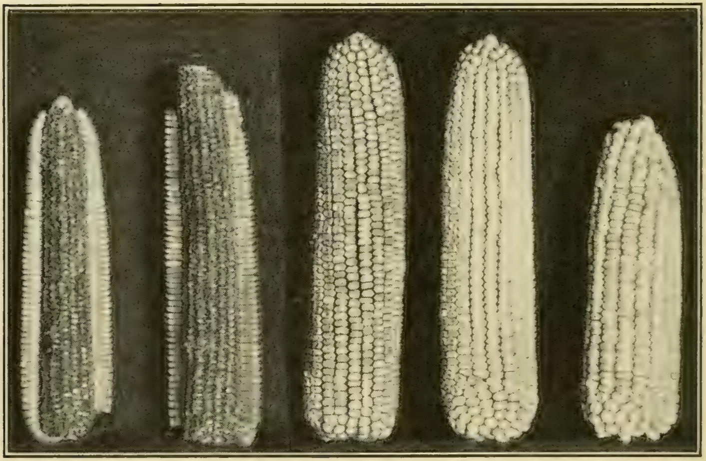

Fig. 30. — Spacing of kernels on cob. The ear at the left shows kernels that are close in the row. The next ear shows kernels that are loose and open, indicating poor development at the tips. The three ears at the right show spaces between the rows. The short ear at the right has small irregular spaces; the middle one of these three is almost ideal, the next to the left shows wide spaces between the rows.

as to depth, width, and shape, and consequently are not wanted. From corn breeding experiments at several experiment stations it has been determined that irregularities are transmitted by the mother ear to the progeny, therefore if one desires to make the most rapid advancement in breeding to a highly developed type, he should select only the ears regular in all characteristics.

The furrow or groove should not descend to any great

depth but merely mark the dividing line between the kernels from butt to tip. Where the furrow is deep, thereby exposing a large portion of the surface of the kernel, it indicates that the corn is badly off type.

The amount of space between kernels at the cob indicates maturity and vitality. The kernel tip in immature corn is shriveled and therefore leaves a space readily detected. In well-matured corn no noticeable space will be found, but the kernels will fit tightly together from tip to crown.

Rule for Scoring. — Cut .25 of a point for $\frac{1}{32}$ to $\frac{1}{16}$ inch furrows, and cut .5 of a point for $\frac{1}{16}$ inch and above. Cut .5 of a point for each ear showing space between kernels at the cob.

PERCENTAGE OF GRAIN TO COB

Perfect Score. — The percentage of grain should equal the standard for the variety. Perfect score, 10 points.

Directions for Judging. — Good, well-matured corn should show a ratio of from 84 to 87 per cent grain to cob. In other words, if we were to shell 100 pounds of ear corn, we would get approximately 84 pounds of kernels and 16 pounds of cobs. The tendency with some corn growers is to look for a small cob, thinking that feature of corn to be the leading desirable characteristic. In many instances the selection of small cobs has been practiced to such an extent that the yield of grain has been materially reduced.

One should choose a medium-sized cob that will carry from 16 to 20 rows of kernels of medium depth. If the size of the cob is reduced the ear simply drops its rows by pairs until we have but 10 or 12 rows remaining. If, on the other hand, the cob is too small and the grower has been working for a high percentage of grain to cob, the kernels are

apt to be of too great depth to mature well in northern climates. Immature and chaffy corn gives a relatively low percentage of grain to cob compared with well-ripened corn.

When judging corn for percentage of grain to cob, weigh five ears of the sample and record the total weight. Then

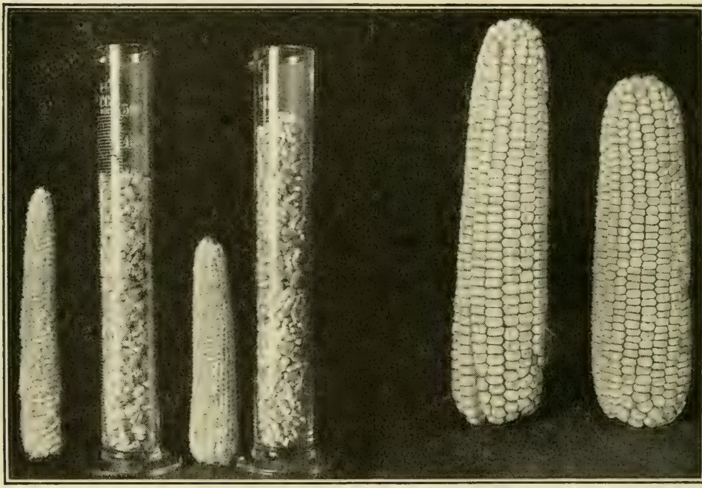

Fig. 31. — Proportion of cob to grain. The cobs and grain of the two ears at the right are shown at the left. The shorter ear with thicker cob had more grain than the long ear with the slender cob. The percentage of grain to cob cannot be judged accurately with the eye, and the grain should be shelled off and both cob and grain weighed to determine this point.

shell and weigh the grain and record the weight. Divide the number representing the weight of the shelled grain by the number representing the weight of the ears and the result will be the percentage of shelled corn.

GENERAL CUTS

Directions for Judging. — A defect may be so serious that it should cut down the sample as a whole over and above the cuts given on the ears. An ear in a sample of

yellow corn showing all kernels mixed and whitish would indicate that the ear was crossed with white corn and wholly unfit for seed. A white cob in yellow corn, or a red cob in white corn, indicates reversion which is nearly as bad. Any condition which shows that the corn will not germinate would be a defect serious enough to score directly against the sample as a whole.

Rules for Scoring. — A cut of 10 points should be made for every ear that is crossed, as shown by a great preponderance of kernels of a different color or type.

A cut of 5 points should be made on every ear of yellow corn having a white cob, or an ear of white corn having a red cob.

Every ear that is diseased or damaged in any way so that none, or practically none, of the kernels will germinate, should be cut 10 points.

If the sample as scored in the previous example gets a rating of 69.5, and the general defects as above cited demand attention, there should be deducted from the score the number of points deemed necessary for such defects.

General score	69.5
Cuts for general defects	5.
Final score	64.5

JUDGING SMALL GRAINS

Small grains are usually judged under the following heads: trueness to type or breed characteristics; uniformity in the size and shape of kernels; color of grain; freedom from mixture with other grains; size of kernel; freedom from weed seed, dirt, and other foreign material; weight of grain per bushel; viability; damaged, smutty, or musty kernels; hardness and texture.

Trueness to Type. — In judging trueness to type in samples of grain we take into consideration those characteristics which are common to that particular variety of grain. To be true to type all the kernels should bear a close resemblance to each other. Some kernels may be smaller than the others, but should have the same general appearance, the same markings, and the same color.

Some varieties of oats, for example, have short, plump grains, others have long, slender, or pointed grains. Some varieties with short, plump grains have large kernels, others small, and the same is true of those varieties having long, slender grains. These same observations apply in a greater or less degree to barley, wheat, and rye. In general, the points which determine type are color, size, and shape of kernel, presence or absence of awns and hulls in oats; presence or absence of beards and hulls, and the straightness or crookedness of the kernel furrows in barley; and the color, size, and shape of kernels in wheat. Oats may or may not have hulls. They may be white, yellow, gray, red, or black or have different sizes and shapes of kernels, depending upon the variety, but there should be no mixture of one variety with another.

Barley may or may not have hulls, or beards; they may be black, blue, or white. The kernels may be long and slender, or short and plump. The furrow in a kernel of barley may be straight or crooked, depending upon the arrangement on the flower stem. In six-rowed barley, two thirds of the grains have crooked furrows. In two-rowed barley, the furrows are straight. No mixture of these classes is allowable.

Wheat may vary in color from white to a dark red, and may be hard or soft, depending upon the variety and the

region where it is grown. The kernels may possess a wrinkled surface or be perfectly smooth; some may be long and pointed and others short and oblong, depending upon varieties. It is important that these different types be not found in the same sample if it is to be considered as true to type.

Uniformity in Size and Shape of Kernels. — In an ideal sample of grain, all the kernels should be the same size and shape. They may all be small or all be large, but they must be all of uniform size and shape. This is important because the grain may then be sown at a more uniform rate and all plants grown therefrom are likely to be of equal strength and vigor.

Color of Grain. — All kernels in the sample should be of the same color. No black, red, gray, or yellow oats should be found in a sample of white oats. No mixture of light and dark or red and white wheat is allowable. The last rule, of course, applies equally to the grains of other colors. This point must be closely watched, as it is an indication either of mixture or of a lack of breeding.

Freedom from Mixture with Other Grains. — The value of grain for seed is greatly reduced whenever there is a mixture of other grains. Special application of this point can also be made to wheat and barley for other reasons. Wheat to make the best flour should be absolutely pure and the best prices can be obtained for it when it is of that grade. In the manufacture of malt, maltsters wish to use only pure barley, and a mixture of other grains is undesirable. Oats in barley are especially objectionable, as it is extremely difficult to separate them from the barley.

Size of Kernel. — The size of the kernels should be considered. In any grain it is desirable to have the kernels as

Fig. 32. — Corn grown from well-selected stock.

large as possible, up to a certain limit. Therefore, all the grains of a sample should be large for the variety, as this is an indication of a well-matured and vigorous grain. In other words, the kernels should be large and plump, not undersized or shrunken.

Freedom from Weed Seed, Dirt, and Other Foreign Material. — The grain should be free from all kinds of foul material. A sample is at once scored against heavily if not thoroughly clean. The cut should be much more severe if among the weed seeds in the grain there are those of noxious weeds, such as Canada thistle, quack grass, and wild mustard. Cracked and shrunken grain, weed seeds, and other objectionable materials should be separated from the good grain. The farmer should make this separation himself. The increased price obtained for the cleaned grain will ordinarily more than pay for the cleaning, and the screenings can be converted, by grinding, into a good grade of ground feed for stock. The grain can be cleaned on rainy days or in winter when the value of labor is low. The full value of a good fanning mill or grain grader is seldom realized.

Weight of Grain per Bushel. — The weight of grain per measured bushel is usually an indication of quality and is the principal point by which grain inspectors and buyers determine the grade and market value of grain. In wheat, high weight is indicative of comparatively high protein, or more specifically, gluten content, and it is the amount of gluten in wheat which determines its bread-making qualities. In barley, the same rule applies. Feeders of live stock want a high protein barley.

In oats the higher the proportion of meat to hulls the better the feeding value of the oats, as the hulls consist

largely of crude fiber. The heavier the oats the higher the percentage of meats and the lower the percentage of hulls. The average per cent of meat to hulls for oats in the United States is 70 per cent, but may vary greatly, depending upon the season, the quality, and the variety of oats.

Viability. — For the best results no seed grain should have a germination test of less than 95 per cent. A higher percentage of germination is more desirable. Germination should be strong and vigorous, resulting in a strong, rapidly growing young plant.

Damaged, Smutty, or Musty Kernels. — Wheat should contain no smutty or musty kernels. The smut darkens the flour and gives it a bitter flavor. If musty kernels exist in any quantity in the wheat, the flavor can at once be detected in the flour. Both of these conditions lower the value of wheat for any purpose and when very bad render it utterly valueless for the making of flour.

Barley should also be free from these same defects. Smutty or musty barley is worthless for pearling purposes or breakfast foods, and it also makes poor feed for stock. Oats also should be free from smut.

Hardness and Texture. — Texture is very important when considered in connection with wheat, barley, and rye. The hardness or softness of the berry is recognized by its texture. Its true value as a flour-producing cereal is determined by its hard flinty character.

Excessive discoloration, sprouted kernels, and immaturity are the most important factors affecting the texture in grains. Texture is readily disclosed by cutting crosswise a number of the kernels in a sample.

Odor of Oats. — The odor of oats should be sweet. There should be no musty or burnt odor that indicates that

oats are not in good keeping condition, or that they have been overheated in the bin or stack. Such conditions have a tendency to destroy both the seed and the feed value of the grain.

Elevator men often resort to a process of bleaching to whiten oats that have been blackened or otherwise injured by exposure to the weather. Sulphur is used as the bleaching agent and oats thus treated often retain the smell of sulphur. Oats or barley treated in this way should be avoided as they are apt to be injurious as feed, and often the vitality or germinating power is destroyed or seriously impaired.

Score Cards. — Score cards for use in the judging of small grains are to be found in the several chapters dealing with these products.

EXERCISES

1. After shelling an ear of corn that weighed 12 ounces it was found that the corn weighed 10 ounces and the cob 2. What was the per cent of corn to cob?

2. If it cost $1\frac{1}{2}$ cents an ear to test seed corn, how much would it cost to test the seed corn for 640 acres of land, if it required 15 ears of seed corn per acre and if only 75 per cent of the tested ears were sufficiently good for seed?

3. If the testing of the seed was the means of increasing the yield 5 bushels per acre, and corn was worth 60 cents per bushel on the market, how much money would a farmer get for the extra yield on the 640 acres?

4. Compare four yellow varieties of corn and two white varieties for breed characteristics.

5. Determine percentage of corn to cob by weighing the cobs and shelled corn.

6. Soak kernels of corn for a half hour in hot water, then

divide the kernel into the following parts: tip cap, hull or outer covering, sticky layer underneath hull, hard and soft starch, and the germ.

HOME PROJECTS

1. Prepare threshed grains for show purposes:

The first step is to get plump grains with good color. Rain will discolor oats and barley and make them unfit for show purposes. This can be avoided by hauling in a small load of the bundles and letting them cure in the barn. Then thresh this grain separately. Later run the grain through the fanning mill and grade out all light seeds, chaff, and foreign matter, and retain the large heavy kernels. Get a half bushel or more ready. Pick out by hand any bad kernels you may find. It is not a difficult matter to prepare a show sample of any good grain.

2. Prepare sheaf grains for exhibits according to the following directions. Pick from your field some good, ripe heads and tall stalks of oats, barley, wheat, rye, or whatever grains you may be growing and allow them to cure under cover. Then strip off all leaves of each stem, and put together in a three- or four-inch bundle. Try to secure well-filled heads and as bright straw as possible.

The rules and requirements relating to samples of grains issued by the persons in charge of exhibits should be carefully studied by exhibitors.

CHAPTER IV

WHEAT

History. — Wheat has followed civilization throughout the world and has made it possible for us to obtain a wholesome food at a relatively low cost. No other crop has so important a place in international commerce, and no other has exerted a greater influence upon the human race.

Wheat was first grown as a food in southwestern Asia and from there carried into Europe and Africa. It is thought that wheat was first brought to the western continent by Cortez at the time of the Spanish conquest. Barley vied with wheat as a human food in Europe and Asia for many centuries, but wheat gradually gained in favor and is now the popular bread-making cereal of the world.

Classification and Varieties. — There are eight different species or subspecies of wheat which are now cultivated; namely, Einkorn, Polish wheat, Emmer, Spelt, Club wheat, Poulard wheat, Durum wheat, and common wheat.

This chapter deals principally with the common, bread-making wheat. There are numerous varieties of common wheat, but for all practical purposes they can be classified as spring wheat and winter wheat, of which there are hard and soft varieties, likewise bearded and beardless varieties. The hard and soft winter wheats may be either red or white in color.

The Turkey Red wheat with its several subvarieties is most widely grown as hard winter wheat and the Fultz as

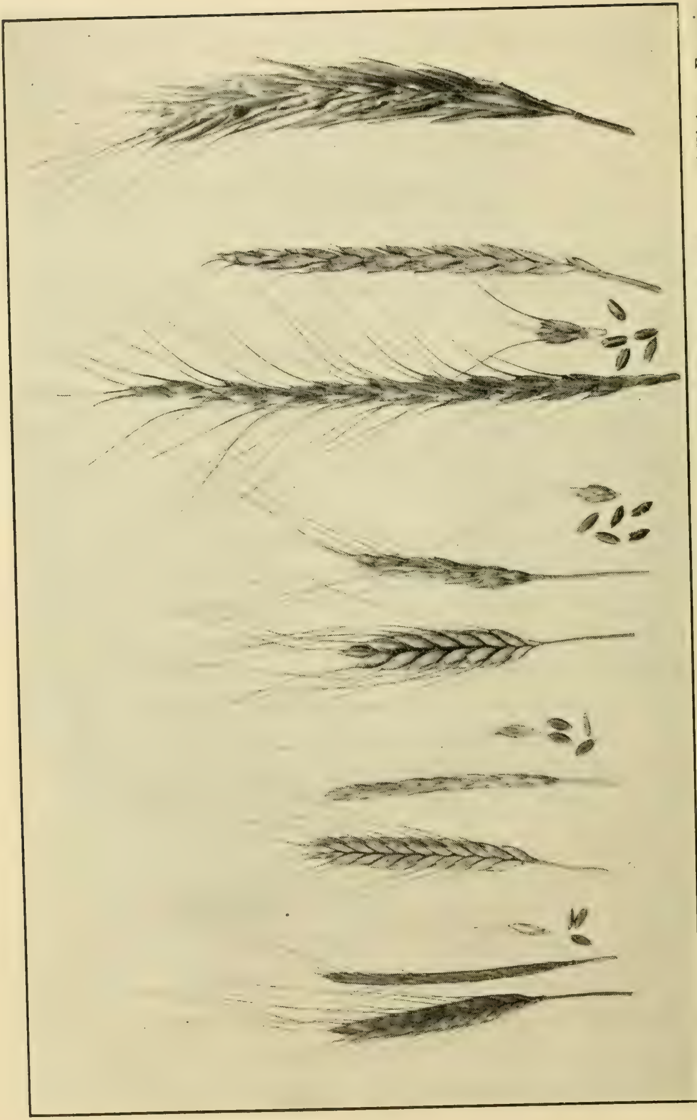

Fig. 33. — Lower forms of wheat. From left to right are shown front view, side view, spikelets, and kernels, of Einkorn, Engrain, Emmer, and Spelt. At extreme right is a single head of Polish wheat.

soft winter wheat. The Fife, Marquis, Bluestem, and Velvet Chaff are best known and most widely grown as hard spring wheats. The Velvet Chaff is a bearded spring wheat of the Fife variety, but is considered inferior to Fife and Bluestem as a bread-making wheat.

The type of wheat known as the Durum or Macaroni is now quite generally grown in the semiarid regions of the

Fig. 34. — Some common strains of wheat. From left to right, Turkey Red, Fife, Velvet Chaff, and Bluestem. The Fife and the Bluestem are beardless.

United States. This wheat is drought and rust resistant, and for these reasons is quite popular in those regions. It is very hard and high in gluten content but loses these properties and its resistance to disease if grown in a moist climate. The Durum wheats are bearded spring varieties.

Habits of Growth. — Wheat is similar to barley or oats, but it tillers more heavily, sending up several well-developed stems from a single seed. It usually receives its plant food from the surface soil, but where the subsoil is not too hard it will penetrate that also for food and moisture. Like

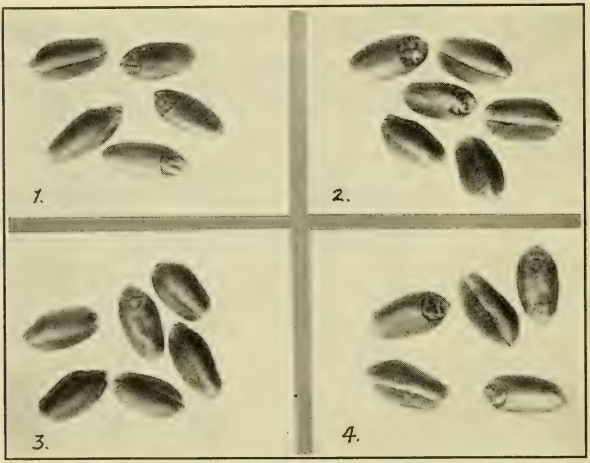

Fig. 35. — Kernels of the strains of wheat shown in Fig. 3: 1. Turkey Red; 2. Fife; 3. Velvet Chaff; 4. Bluestem.

most of the small cereals the stems of wheat are jointed and hollow, and grow to a height of three to five feet.

Preparation of the Seed Bed. — Wheat needs well-drained land in a high state of fertility. It is useless to attempt to grow wheat on light sandy soils or on bottom lands that are not well drained. A medium to heavy clay or a clay loam well filled with humus is to be preferred for wheat. Like other crops, wheat responds to good treatment, and farmers find themselves amply repaid in increased yields and good quality for giving extra care to the preparation of the seed bed.

For spring wheat it is a good practice to have land fall plowed, so that the disk harrow may be run over the ground in the spring as soon as the soil works well. The disk harrow should be followed by the fine-tooth harrow so as to fine the soil and make a mellow seed bed.

Winter wheat usually follows a cultivated crop or another grain crop. The ground is plowed and prepared soon after the previous crop is harvested. When put on mellow corn land often no plowing is necessary as disking is sufficient to prepare a proper seed bed.

Grading, Testing, and Sowing the Seed. — Wheat should be run through a grain grader or fanning mill so that weed seeds, dirt, and broken and shriveled kernels can be separated from the seed. By grading carefully the light inferior kernels can be separated from the plump heavy ones, and thus prevent "running out" which in time occurs where the grading of the seed grain is not practiced. All seeds planted on the farm should be tested for germination before planting. Wheat and other small grains can be tested in the same manner that alfalfa seed is tested as described on page 144, under the head "Testing the Seed."

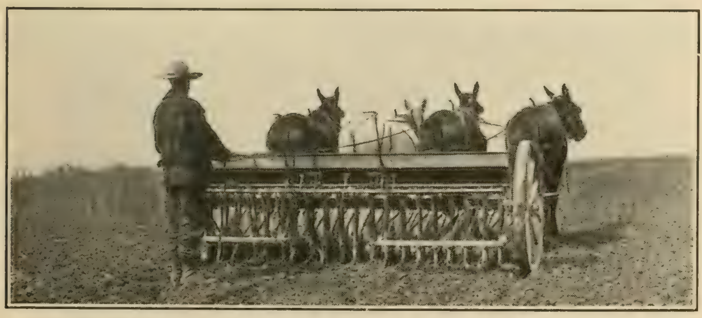

Fig. 36. — Seeding wheat with a four-horse drill.

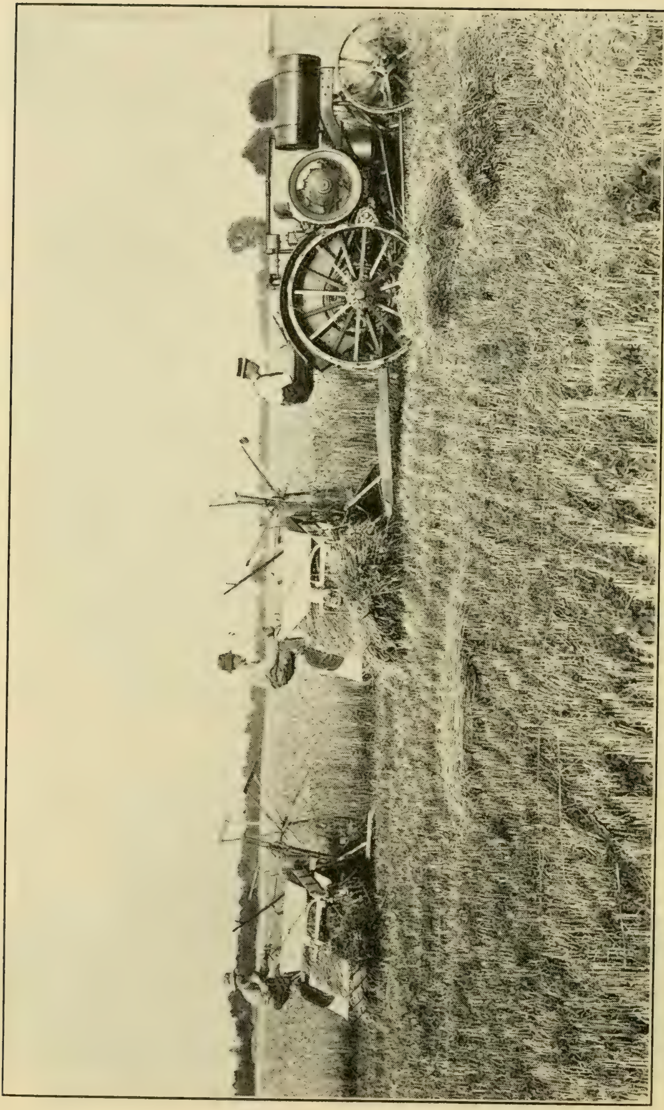

Fig. 37. — Harvesting wheat with binders drawn by an oil tractor.

Wheat is sown with a drill or with a broadcast seeder at the rate of 1.5 to 2 bushels of seed per acre. In sowing with a drill, which places all the kernels beneath the surface of the soil, usually a less amount of seed need be used than when it is sown with a broadcast seeder. Where fall grains are sown the furrow made by the drill aids in holding snow, which prevents the freezing out of the grains. On ground that has been newly cleared and on rocky lands the broadcast seeder can be used to advantage.

Harvesting. — After seeding no further labor is necessary on the wheat fields until time for harvesting. The

Fig. 38. — Harvesting wheat with a grain binder. The bundle carrier attachment is at the extreme right.

grain binder is most generally used for this purpose. This machine cuts and binds the grain, and if provided with bundle carrier attachment, drops the sheaves at such intervals as the operator desires. In some parts of Canada and in the Western States headers and combined harvesters and threshers are used for harvesting the crop. These machines can be so gauged as merely to cut the heads off the

wheat, and drop the same in an elevator that carries the grain through a cylinder from which it comes out threshed and ready for the sack. These machines are used in the semiarid regions where grain seldom lodges, and where a large acreage is devoted to wheat raising.

On the medium-sized farms the wheat after being cut and bound is put up in shocks and left in the field until quite dry. In many localities the wheat is taken directly from the shock to the threshing machine. In others, it is hauled to a convenient place and stacked or taken directly

Fig. 39. — Wheat in shocks.

to the barn and stowed away to await the threshing machine. If wheat is left for three or four weeks in the stack or in the barn, it will be found in good condition to thresh and will keep well in storage. After wheat is hauled from the fields and stacked or stored away in barns it goes through a sweating process. This lasts for two or three weeks depending upon the ripeness and dryness of the wheat when stored away. If threshed during the time it is going through the sweat, the straw and grain will be found to be damp. The straw is tough and will not run through the machine readily and the wheat will heat and mold

when stored. If wheat is found to be in the sweat at the time of threshing it is well to store in large shallow bins where it can be shoveled over at frequent intervals until dry. In the wheat-growing regions there are many elevators where grain is taken immediately after threshing and there cleaned, sweated, and stored for future shipment. Much of the wheat is manufactured into flour at the great milling centers and sent from there to different parts of the world.

Fig. 40. — A grain elevator.

Rotation. — Wheat should be grown in a rotation with a leguminous and a cultivated crop. Good rotations for wheat are the following:

THREE YEAR ROTATION

First Year. — Corn, potatoes, or root crops on young sod.
Second Year. — Wheat, seeded down with clover.
Third Year. — Clover, first cutting used for hay; second, turned under.

FOUR YEAR ROTATION

First Year. — Corn, peas, potatoes, or root crops on young sod.
Second Year. — Wheat, seeded down with clover and timothy.
Third Year. — Clover, two cuttings of clover, pasture in the fall.
Fourth Year. — Mixed hay, fall plowed for corn.

FIVE YEAR ROTATION

The same as the four except the field is not plowed at the close of the fourth year of the rotation but is run the fifth as pasture. The five year rotation is common where a large amount of stock is kept on the place and much pasturage is necessary.

By following a good systematic rotation where the fields are treated with manure at least once in four years and also have a cultivated and leguminous crop grown during that time, the ground will be kept in a good state of fertility and paying crops of wheat can be obtained.

By growing the wheat crop only one year in four, insect enemies and diseases that usually prey upon the crop will be eliminated from the soil. The cultivated crop grown during the rotation will eradicate the weeds and retain moisture; and the leguminous crop will add nitrogen and humus to the soil, which are so necessary in wheat growing.

Enemies. — Some of the enemies of wheat that have prevented good yields in the past are rust, smut, scab, Hessian fly, jointworm, chinch bug, army worm, midge, stem maggot, wireworm, weevil, and grain moth.

The treatment for wheat smuts is the same as that used for the barley smuts, as outlined in the next chapter. The other wheat pests are partially controlled by rotation and time of seeding.

SCORING WHEAT

Score a sample of wheat according to the following directions.

On a page of your notebook copy the score card on the next page and fill the blank spaces with your scores. Below your score card give your reasons for your score on each of the ten heads. Number your reasons to correspond with the number of each head on the score card.

DIRECTIONS FOR SCORING WHEAT

1. All kernels should possess the characteristics of their type and variety.

Take 100 kernels, constituting a fair sample of the grain. Count out the kernels not true to type into three grades. In

the grade badly off type cut .1 of a point for each kernel. In the next grade cut .1 of a point for two kernels and in the best grade cut .1 of a point for every three kernels. Repeat three times and find the average.

2. Kernels should be of the same size and shape within the limits of the type and variety.

Proceed as in No. 1.

3. The color should be uniform for the type or variety. Discoloration should be severely cut.

Proceed as in No. 1.

4. The sample should be pure wheat.

Take 100 kernels, constituting a fair sample, count out the foreign grains. For each foreign kernel cut .1 of a point.

5. All the kernels should be large and plump for the class.

Separate a sample of 100 kernels and proceed as in No. 1.

WHEAT SCORE CARD

Name and Number of Scorer ....

Sample Number .... Date........................

		1	2	3	4	5
1. Trueness to type or breed characteristics	5					
2. Uniformity in size and shape of kernels	5					
3. Color of grain	10					
4. Mixture with other grains	10					
5. Size of kernel	10					
6. Weed seed, dirt, and other foreign material	10					
7. Damaged, smutty, or musty kernels	15					
8. Weight per bushel	15					
9. Viability	10					
10. Hardness and texture	10					
Total	100					

6. The sample should be free from dirt and weed seeds.

Cut sample .2 of a point for each per cent of foul material.

7. The sample should be free from musty, smutty, broken, or bin-burned kernels, and should have a sweet grain odor.

From a sample of 100 kernels determine the per cent of damaged, smutty, broken, or bin-burned kernels and cut. 2 of a point for each per cent. For bad odor, cut sample from 1 to 10 points.

8. The standard is 60 pounds per measured bushel.

For each pound below 60 pounds cut 1 point.

9. Wheat should give a germination of not less than 100 per cent.

Cut .5 of a point for each per cent germination below 100.

10. The best flour wheats are hard and flinty.

Cut .5 of a point for each per cent of soft, starchy kernels.

HOME PROJECTS

1. Determine the cost of producing an acre of wheat by keeping a record of the following items.

(*a*) Rent of land (estimated). (*b*) Cost of fertilizer (if any). (*c*) Cost of plowing, harrowing, seeding, harvesting, and threshing. Base these computations on records of actual time spent in all labor operations.

2. Grade wheat for seeding purposes.

3. Select threshed samples for show purposes.

4. Grow an acre of pedigree wheat in comparison with a common variety. (Types of wheat, barley, and other grains that have been materially changed by careful selection or crossbreeding for a period of years are designated as "varieties." Where a superior grain has been developed from a single seed and carried through a course of several years of breeding by selection, or hybridization and selection, and an accurate record kept of the same, it is known as a "pedigree" variety.)

CHAPTER V

BARLEY

History. — Barley was known throughout Asia, Africa, and parts of Europe before the Christian Era, and was grown largely for human consumption. As a bread-making grain, it gradually gave way to wheat and rye, and since the fifteenth century has been grown chiefly as an animal

Fig. 41. — A field of barley ready to be harvested.

food and for malting purposes. The early settlers of America brought barley from Europe to the colonies and disseminated it to various sections of the United States. Barley can be grown over a wide latitude, but is restricted to certain states and localities on account of soil conditions.

Classification. — Barley is commonly classified as six-rowed, four-rowed, and two-rowed. The four-rowed does not appear to be a distinct variety but a variation of the six-rowed class. There are bearded, beardless, and varieties without hulls, in each of the above classes. There

Fig. 42. — Some types of barley. From left to right, beardless, two-rowed, six-rowed.

are also fall and spring varieties of barley, as is the case with wheat. The term "variety" is used by seedsmen, plant breeders, and farmers in a wider and less rigid sense than that applied by the botanist.

Habits of Growth. — Barley is an erect annual plant. It does not stool or tiller so heavily as rye, wheat, or oats. On fertile soil, however, as many as six or seven stalks will come from a single seed. It does not grow so tall as rye, wheat, or oats, and the leaves of the plant are broader during the earlier period of growth. It matures earlier than most varieties of wheat and oats, and consequently can be harvested earlier. Its roots grow near the surface of the soil and it does not feed so extensively as oats or wheat, therefore it requires a well-subdued, mellow, rich soil with fertility near the surface. No crop responds more readily to good tillage, and the prudent farmer soon finds that it pays to put extra cultivation with disk and fine-tooth harrow upon the land to render plant food available and to prepare a good mellow seed bed for this crop. It is useless to try to grow barley upon poor sandy lands or worn-out soils; neither does it do well on ground that has been newly cleared, or is poorly drained.

Fig. 43. — Plants of pedigree barley.

Fall plowing is preferable on clay or clay loam soils as the winter weathering helps to disintegrate the soil particles and to secure good tilth. The ground should be disked as early as it will work well in the spring and then finished with

a fine-tooth harrow. Ground that is "lumpy" after disking should be run over with roller or planker previous to harrowing. If ground is spring-plowed it should be run over with fine-tooth harrow the same day that the plowing is done, to prevent the surface of the furrows from becoming dry and hard.

Testing the Seed. — All seed barley should be tested for viability before sowing, as its vitality is often injured by heating in the stack or bin. If the seed is of low vitality and does not test as high as 90 per cent it should be regarded as inferior, and new seed should be purchased or the ground upon which the barley was to be sown put into other crops.

Sowing the Seed. — The seeding of barley should follow that of oats and spring wheat, as an early spring frost is more injurious to young barley plants than to other small cereals. A drill or broadcast seeder is commonly used and the barley is sown at the rate of 1.5 to 2.5 bushels per acre. Where it is desirable to seed the land down to clover, timothy, or alfalfa with barley as a nurse crop, one bushel of seed per acre is sufficient.

Harvesting the Grain. — Objection has been made in the past to the barley beards during harvesting and subsequent handling. This objection has been largely removed since the introduction of binders, self-feeder attachments to threshing machines, and straw stackers. The prejudice against the use of the straw for feed or bedding for stock has little foundation.

Barley should be harvested when well ripened and when straw and heads are of a golden yellow color. If cut when the straw is green, the kernels will shrink and assume an undesirable ashen color. If the bundle carrier attachment

to the harvester drops the bundles at the right points, little handling will be necessary. The shocking should be done on the day of the cutting. By putting up round shocks, using eight bundles for foundation and two bundles for cap sheaves, the barley will be protected from dew, sunlight, and rains which decrease its market value by injury to its color and vitality.

The length of time that barley should be left in the shock depends upon the weather, the ripeness of the crop when

Fig. 44. — A field of barley in shock.

cut, and the abundance of weeds bound up with the barley. After the barley has had ample time to dry thoroughly it should be drawn to the barn and stored therein or stacked conveniently for threshing outside. The lack of sufficient help and barn room has led many barley growers to thresh directly from the shock. This practice does not permit the barley to go through its natural sweating process while in the straw. It will then sweat in the bin and extreme heat

will often accompany the sweating process. This causes deterioration in quality that can in no way be overcome by subsequent treatment.

Threshing. — If the farmer has insufficient room in which to store the sheaf barley, it is best to stack outside and leave the barley in the stack at least a month before threshing. If the barley is stacked or drawn to the barn, the cap sheaf bundles should be stored and threshed separately, as much discolored grain will be found in these bundles and this should not be mixed with other barley. Care should be taken while threshing not to have the beards cut too close to the kernel. If the kernel is exposed, it injures germination and favors the action of molds during the sprouting process.

Marketing the Crop. — Barley serves as a ready money crop for most growers and is usually put on the market soon after threshing. It is not a good practice to put weather-beaten or damaged barley on the market as the price will be cut severely even though the feeding quality is but slightly impaired. It is far better to use such injured barley on the farm and secure both feeding and fertilizing value from it.

Farmers should grow but one variety of barley and that of the very best. Varieties should not be mixed when being put on the market either as seed or malting barley. Different varieties of barley when placed on the malting floor germinate at different periods of time. This causes a loss and a corresponding reduction in price. The maltster and the barley pearler desire a barley of one distinct type. This should be uniform in quality and size of berry.

Rotation. — Barley should be grown in a three or four years rotation where it follows corn, potatoes, peas, or root

crops that have been grown on plowed sod land. The land should be seeded down to clover and grasses at the same time or immediately after the barley is sown. By following this system of rotation the seed is put into ground that has an abundant supply of vegetable mold occasioned by the decayed sod.

Diseases and Insect Enemies. — Barley is comparatively free from diseases and insect enemies. It is, however, affected with rust, leaf stripe, and smut. Little has yet been accomplished in preventing rust but good work has been done in the eradication of smuts. In a few instances rustproof varieties of grains have been bred for distinct localities.

Eradication of Barley Smut. — Barley is attacked by two varieties of smut, — the loose smut and the closed smut, the former being the more prevalent and the harder to eradicate. The loose smut is noticeable as soon as barley begins to head; the black smutty heads may be seen pushing out from the sheath in which they are inclosed. A few days after the smut makes its first appearance it will have ripened, and the spores will be wafted by the wind to a hiding place in the immature kernels where they remain secure until the kernels are planted the following year. After the smut is blown away nothing is seen to indicate disease except the light blackened tip of the barley plant where the spike should be.

Formaldehyde Treatment for Barley Smut. — For eradication of loose smut submerge the barley for two hours after being sacked in formaldehyde solution. Formaldehyde solution is made by putting one pint of formaldehyde in 30 gallons of water. The above treatment will also eradicate leaf stripe.

Hot Water Treatment for Smut. — Place the barley in gunny sacks and submerge in cold water for 12 hours. Remove and drain for an hour, then submerge for 5 minutes in a cask containing hot water, held at a constant temperature of 130 degrees Fahrenheit. It is well to warm the barley before placing it in the hot water by submerging it in water at a slightly lower temperature for a minute or two, otherwise the temperature of the water in the cask will be materially lowered. Boiling water should be kept near at hand, and added at intervals to keep the temperature nearly constant. In adding the boiling water, it should never be allowed to come into direct contact with the barley, as the vitality of the seed will be injured or destroyed.

After the hot water treatment, the seed should be spread upon the barn floor to cool before sowing. It should be sown the same day or the day after treatment, otherwise it will sprout and difficulty will be found in getting it through the seeder or drill.

The margin of temperature which is effective for the destruction of the smut spore is so narrow that the operator must be supplied with a good standard thermometer and watch the process closely. If the water in which the seed barley is submerged is but slightly above 130 degrees, the seed will be injured, and if a few degrees lower the smut spores will not be killed. On account of the liability of error it is advisable for barley growers to treat only a sufficient amount of seed to sow two or three acres and save seed for future sowing from this particular field which will have little or no smut in it. The closed smut of barley is readily eradicated by the formaldehyde method, if treated as recommended for oats in Chapter VI.

SCORING BARLEY

Judge samples of barley. Use the score card as shown below, and note carefully the points to be observed and rules for cuts. After a little practice it can be done quickly and accurately. Copy the score card in your notebook and fill the blank spaces with your scores. Below it write your reasons for your score on each of the ten heads of the score cards. Number your reasons to correspond with the points on the score card.

BARLEY SCORE CARD

Name and Number of Scorer ....

Sample Number ....Date ....

		1	2	3	4	5
1. Trueness to type or breed characteristics . . .	5					
2. Uniformity in size and shape of kernels	5					
3. Color of grain	15					
4. Mixture with other grains .	10					
5. Size of kernel	10					
6. Weed seed, dirt, and other foreign material . . .	10					
7. Damaged, smutty, or musty kernels	10					
8. Weight per bushel . . .	15					
9. Viability	10					
10. Texture	10					
Total	100					

DIRECTIONS FOR SCORING BARLEY

1. All kernels of the sample should resemble one another in shape, color, and general appearance.

2. Kernels should be the same size and shape throughout to secure uniformity.

3. Grain should all be light or golden yellow in color.

4. It must be pure barley. There should be no mixture of oats, wheat, or any other grain.

5. The sample as a whole should consist of large and plump grains, not small or shrunken ones.

6. The sample should be free from dirt and weed seeds. The per cent of foul material is determined by the use of sieves and scales. Should the foul material consist of noxious weed seeds, the cut on sample should be made more severe than if it is composed of practically harmless materials.

7. The sample should be free from smutty, musty, or bin-burned kernels. Take 100 average kernels and count the number of smutty or otherwise injured kernels. Repeat this three times and find the average of the three trials. The number found will be the per cent of poor kernels.

8. Good barley should weigh 48 or more pounds to the measured bushel. The weight per bushel may be determined by the use of the Winchester measure.

9. Barley should give a germination of not less than 95 per cent.

10. Sample should be free from excessive discoloration, sprouted kernels, immaturity, and soft berries.

RULES FOR CUTS

1. Take 100 kernels constituting a fair sample of the grain and count out the number not true to type. Repeat three times and find average of the three trials. For each kernel off type, cut .1 of a point.

2. Proceed as above and for each small or shrunken kernel cut .1 of a point.

3. For discoloration cut according to extent. If only slightly discolored cut 1 point, or more as per cent of discoloration increases.

4. Weigh the whole sample, separate and weigh the foreign grain. This will give per cent of other grains. For every per cent so found cut .5 of a point.

5. Sample should consist of large plump kernels, not small ones. Cut as judgment dictates, considering variety characteristics.

6. Cut sample 1 point for each per cent of foul material.

7. Cut sample 1 point for each per cent of smutty, bin-burned, or musty kernels.

8. Cut 1 point for each pound below 48 pounds in weight.

9. Cut .5 of a point for each per cent the germination falls below 95 per cent.

10. Cut as judgment dictates in accordance with extent of discoloration and number of soft or sprouted kernels.

Fig. 45. — A sample of barley for exhibit.

HOME PROJECTS

1. Grade seed barley before seeding. If a large quantity of barley is on hand, which after seeding time will be used for feed, it is well to make the grading very close, retaining for seed less than half of all the barley put through the grader. When shriveled and shrunken kernels, which are always low in vitality, are eliminated from the seed, the "running out process" will

be entirely overcome. A fanning mill with proper sieves is necessary to carry out this project.

2. Treat barley with formaldehyde to destroy closed smut.

3. Treat barley with hot water to destroy loose smut.

4. Pick smutty heads from one tenth of an acre plot as soon as they appear, and save the remainder for the increase field.

5. Grow an acre of pedigree barley. Compare the yield and quality with common or scrub barley.

6. Find the cost of producing an acre of barley.

7. Prepare sheaf samples of barley for show purposes.

CHAPTER VI

OATS

THE original home of the oat plant is Asia, where it was grown at an early date as an animal food and used occasionally in seasons of partial failure of crops as a human food. Its value as an animal food and the ease with which

Fig. 46. — A field of pedigree oats ready to be harvested.

it could be grown caused its rapid dissemination throughout Europe and America. It is regarded as an excellent food for horses. It is used also for human food, as oatmeal and other breakfast foods. Oat straw is fed to stock and is extensively used for bedding.

Habits of Growth. — The oat belongs to the grass family. It usually grows from 2 to 4 feet high, depending upon the variety and the nature of the soil upon which it is grown. The roots of the plant are long and fibrous, and run down to a depth of 1 to 2 feet on rich mellow soils in which drainage is good. The plant resembles wheat and barley in its early stages of growth, but later it branches more profusely and is more leafy.

Varieties. — There are numerous so-called varieties, the names of which have been applied by seedsmen and growers.

Fig. 47. — Different kinds of oat panicles. The one at the left is an example of side panicles; the other three are those of open panicles. The one on the extreme right is Wisconsin Pedigree No. 1.

For all practical purposes they can be classified according to color and time of maturity. There are white, yellow, black, gray, and red oats; and early, medium, and late strains in each variety. Some of the prominent varieties grown in the Northern States are Swedish Select, Silver Mine, Big Four, American Banner, White Bonanza, White

Fig. 48. — An oat harvest scene in the West where the header and often the combined header and thresher are used.

Russian, and Champion. The Sixty Day or Kherson represents one of the best examples of the early short-straw varieties. This variety is grown extensively on the low rich grounds where the later maturing and long-straw varieties are likely to rust and lodge.

The agricultural experiment stations of America and Europe are now breeding special varieties of oats that are superior in yield and quality to the common oats used in past years.

Soil and Climatic Conditions. — Oats can be grown under a wide variation of soil and climatic conditions. For best production a cool climate and a rich clay loam are most favorable. Oats may serve as a crop for newly cleared lands or they can be grown on old soils. They are an excellent nurse crop with which to seed down fields to the various grasses and clovers. When used as a nurse crop with clover only about 1 bushel of seed is used per acre, otherwise oats are usually sown at the rate of from 2 to 3 bushels per acre.

Harvesting and Threshing. — Oats are ready for the harvester in 80 to 120 days after seeding and should be cut as soon as the leaves and stalks have turned yellow. When used for hay they should be cut while yet green but after fully headed. If used for hay the oats are cut with a mower, and in curing are handled like our common grasses or clovers. When harvested for the grain, oats should remain in the shock for 3 to 5 days and then be hauled into the barn or stacked. Before threshing they should be left in the barn or stack for 2 to 3 weeks to go through the "sweat," otherwise they will heat in the bin after threshing. Threshing directly from the field reduces the quality of the oats and should be condemned.

Rotation. — Oats should be grown in a three- or four-year rotation and follow corn, peas, potatoes, or root crops. It is best to seed down to clover and timothy so as to have a hay crop following the oat crop. When oats are grown continuously on the same field, depletion of the soil soon follows.

Diseases. — Smut and rust are the two principal diseases affecting oats, and often a fourth to a half of the entire

Fig. 49. — Shocking oats.

crop is ruined by these diseases. Rust may be controlled by practicing a strict rotation of crops and by sowing the early maturing varieties early in the season.

Oat Rust. — Oats are more likely to rust on river bottoms or on low rich soils where the drainage is not good. Near lakes and rivers where the country is subject to fogs the development of the rust spores is greatly facilitated. The

volunteer crop which grows in the fall from the oats shelled by harvesting is usually more or less affected and these spores affect the following crop, hence the necessity of rotation. Oats that are immune from rust can be bred for certain localities, but if carried a distance and put under a different environment, they seem to lose this immunity and become as susceptible as are other varieties.

Fig. 50. — Two heads of oats grown from the same lot of seed. The head on the right was grown from seed that was treated to prevent smut; the other was grown from untreated seed.

Oat Smut. — The oat smut is a disease that is carried over from year to year through the infected seed, and continues to increase until over half of the crop becomes contaminated. The plant becomes infected through spores which find lodgment beneath the oat hull during the flowering period, and remain there until the oat is sown and starts to sprout. The spore then sends up tiny threads through the several culms of the plant and blasts the heads by causing a mass of smutty spores to destroy practically all oats on the affected plants. These spores are wafted off when the oats are in

blossom and find lodgment beneath the glumes of healthy plants.

Remedy for Oat Smut. — A simple remedy, known as the formaldehyde treatment, will effectually eradicate all smut. By making up a solution of a pint of formaldehyde in 36 gallons of water and submerging oats that are loosely sacked for 10 minutes in the solution, the spores will be killed and no smut will appear in the resultant crop. It is well after removing the sacks from the solution to empty oats on the threshing floor and cover them for a

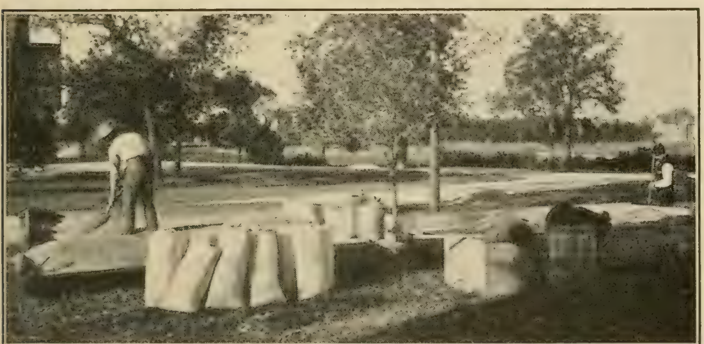

Fig. 51. — Drying oats on a platform after soaking the grain in formaldehyde.

few hours with canvas or blankets to allow the formaldehyde fumes to act effectually on the smut spores. Oats can usually be sown with a drill or seeder a day or two after the treatment. Where a farmer has a large acreage of oats to sow it is best to make up a large quantity of solution and put it in a tank or several barrels so as to treat several sacks of seed at one time. Special machines which make the work easier are now on the market. Any arrangement by which each individual seed is brought in contact with the solution and held there for a short period of time is effectual.

SCORING OATS

Judge a sample of oats, using the directions given below. Copy the following score card in your notebook and fill the blank spaces with your scores. Below it write your reason for each score. Number the reasons to correspond with the points on the score card.

OAT SCORE CARD

NAME AND NUMBER OF SCORER.................................

SAMPLE NUMBER..................DATE.........................

	1	2	3	4	5
1. Trueness to type or breed characteristics 5					
2. Uniformity in size and shape of kernels 5					
3. Color of grain 15					
4. Mixture with other grains . 10					
5. Size of kernel 10					
6. Weed seed, dirt, and other foreign material . . . 10					
7. Damaged, smutty, or musty kernels 15					
8. Weight per bushel . . . 15					
9. Percentage of meat to hull 5					
10. Viability 10					
Total 100					

DIRECTIONS FOR SCORING OATS

1. All kernels should possess the characteristics of their class and variety. Take 100 kernels constituting a fair sample of the grain. Count out the kernels into three grades. In the

grade badly off type cut .1 of a point for each kernel. In the next grade cut .1 of a point for two kernels, and in the best grade no cut is made.

2. Kernels should be of the same size and shape within the limits of the class and variety. Proceed as in No. 1.

3. White oats should be white; yellow oats, bright yellow; black oats, glistening black. Proceed as in No. 1.

4. The sample should be pure oats. Take 100 kernels constituting a fair sample, count out the foreign grains. For each foreign kernel cut .5 of a point.

5. All the kernels of the sample should be large and plump for the variety. Proceed as in No. 1.

6. The sample should be free from dirt and weed seeds. Cut sample .5 of a point for each per cent of foul material.

7. The sample should be free from smutty, musty, bin-burned, shelled, or damaged kernels, and should have a sweet grain odor. Determine the per cent of damaged, smutty, or bin-burned kernels, and cut .5 of a point for each per cent. Cut sample for bad odor from 1 to 10 points.

8. The standard weight is 32 pounds per measured bushel. Cut 1 point for each pound below 32 pounds.

9. The average per cent of meat for American oats is 70. Examine the thickness of hull and length of tip, and cut according to judgment.

10. Oats should germinate 100 per cent. Cut .5 of a point for each per cent germination below 100.

EXERCISES

1. What is the legal weight of a bushel of oats in your state?
2. What varieties of oats are grown in your locality?
3. What kind of soil is best for oats?
4. When are oats usually sown in your locality? When harvested?
5. What uses are made of oat straw? Of the grain?

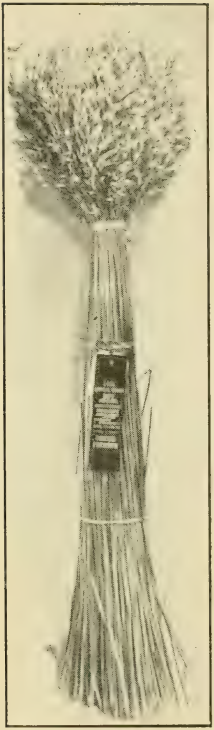

Fig. 52. — A sample of oats for exhibition.

HOME PROJECTS

1. Treat seed oats for prevention of smut, by use of formaldehyde, in the following manner.

Fill an empty kerosene barrel with water to within a foot of the top. Add to this water one pint of 40 per cent formaldehyde solution, stirring constantly. Place oats in burlap sacks and suspend each sack in the formaldehyde solution, completely immersing the sack for ten minutes. Remove and spread out on barn floor to dry.

2. Grade oats for seeding purposes.

3. Select sheaf samples for show purposes.

4. Select threshed samples for show purposes.

5. Grow an acre of pedigree oats and compare the yield with that of an acre of common oats.

6. Determine the cost of producing an acre of oats. Keep a record of each item of the cost.

CHAPTER VII

RYE

Rye belongs to the grass family and is a near relative of wheat. It is divided into two main classes known as spring rye and winter rye, each of which is divided into numerous so-called varieties.

Habits of Growth. — Spring rye is sown in the spring and is harvested from 75 to 100 days after sowing. It does not grow so rank as the fall or winter rye and gives a smaller yield, in consequence of which it has not become popular. The principal rye crop of America and Europe is winter rye and this discussion is confined to that crop.

The growth of rye is similar to that of wheat, but it stools more heavily and withstands drought better. It is a taller plant and will produce a crop on land that is too low in fertility to produce good wheat. It is bearded but not so heavily as to make the beards obnoxious. The straw is clean and strong, and it seldom lodges unless put on very rich mucky soils and sown too thickly. It has perfect flowers and most of them are self-fertilized. Its blossoms are more open than those of most small grains and considerable crossing may occur.

Seed Beds. — While fair crops of rye can be secured on soils too low in fertility for other cereals, it responds quickly to good treatment on better grades of soil. It may be sown on sod land that has grown a crop of hay, or it may follow potatoes, corn, or peas to advantage.

The ground should be prepared by plowing immediately after the above-named crops have been removed. The drag should follow the plow immediately. If ground is plowed and harrowed in July or August, in northern latitudes it can lie until September before sowing the seed. Just before seeding, the disk or other cultivator should be run over the ground. The seed is sown with a drill or broadcast seeder, using from $1\frac{1}{2}$ to 2 bushels of seed per acre.

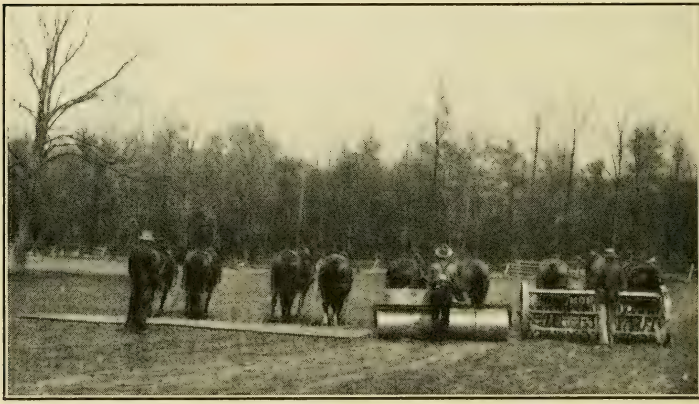

Fig. 53. — Harrowing, rolling, and seeding a rye field.

The smaller amount of seed should be sown on the richer grades of soils as the rye stools more strongly on land high in fertility. The seed can be tested by the method given in Chapter II. (See page 30.)

If the ground has been recently plowed and the land is loose and dry, rolling, after seeding, will assist germination, as through this process the soil particles are brought in close contact with each individual seed. The fine-tooth harrow should be run over the ground once after rolling or before sowing the seed if rolling is not done. If sowing is

done early in September, sufficient growth will be obtained for good fall and winter pasture. Rye can be pastured through the fall, winter, and spring without apparent injury to the crop. It is one of the very best crops with which to seed grasses and clovers. The grass seed can be sown with a seeder attachment to the drill at the same time that the rye is seeded in the fall, and the clover seeding can be done the following spring.

Fig. 54. — A well-developed plant of pedigree fall rye from a single seed.

Harvesting and Threshing. — Rye is harvested in the same way as other small grains and is shocked and later hauled to the barns for storage or put in large stacks to await threshing. When stacked or put in barns it should be left three or four weeks before threshing in order that it may go through the sweat, which is common to all grains and forage plants after harvesting. If threshed while in the sweat, the straw is tough and the grain moist and unfit for grinding. Rye is usually threshed like other grain, and is then put in bins for storage. If threshed from the field or from stacks before going through the sweat, it should be stored in shallow bins and shoveled over frequently until thoroughly dry.

Uses. — Rye is used for the manufacture of flour. A

considerable amount is used also for distilling purposes. The price on the general market is usually somewhat lower than for wheat. Rye flour makes a bread darker in color and firmer in texture than that made from wheat. Rye bread when well made is very palatable and is considered as nourishing as that made from wheat. A small quantity of wheat flour is frequently mixed with rye flour which makes kneading easier, whitens the bread, and improves its flavor. The flavor of rye bread is also modified by kneading a sprinkling of caraway seed in the dough.

Rye is fed to farm animals and makes a fair feed when mixed with corn or other grains. If fed alone as a grain ration to cows, it gives an undesirable flavor to the milk. It is occasionally used for hay and should then be cut at the heading stage. The bran and shorts from rye can be mixed with wheat bran and fed to good advantage.

Rye as a Pasture or Cover Crop. — Rye is considered excellent as a pasture or cover crop. When rye is grown merely as a pasture or cover crop, it is well to sow about thirty pounds of fall vetch seed per acre with the rye. The vetch is a strong nitrogen gatherer and is relished by all farm animals. This practice enables the farmer to add nitrogen and humus to the soil by the growing of the vetch, and to improve the feeding value of the pasture crop. The rye and vetch can be turned under in the spring, and corn, potatoes, or buckwheat grown on the same ground. If desired for hay, the mixture should be left until the vetch is in blossom, when both can be cut and made into hay. The rye acts as a support for the vetch and keeps it from the ground during the growing period. Difficulty is sometimes experienced in curing the hay, but it can be readily cured in good weather.

Rye straw is used extensively as packing material and for the manufacture of straw articles. It is also used in the manufacture of paper and as stuffing for horse collars. When it is put on the market for these purposes it is either hand threshed or run into special machinery which threshes out the heads and leaves the straw in an uncrushed condition.

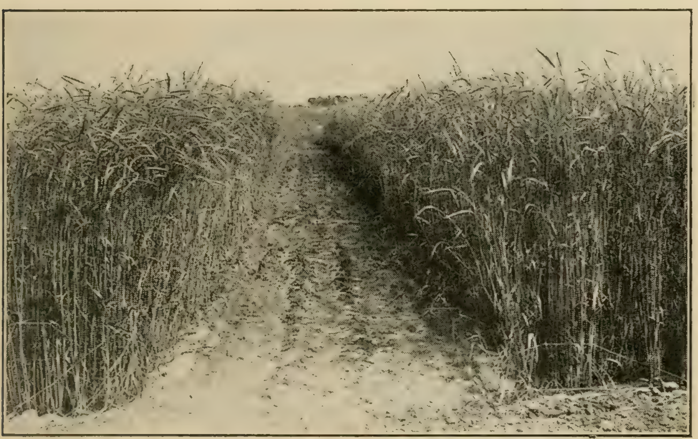

Fig. 55. — Excellence of straw in an average rye field.

Diseases. — The disease most prevalent in rye is ergot. This disease makes its appearance on several of our grasses, but is most common on rye. When rye is thus affected it should not be fed to stock. Ergot is a poison to animals and may cause serious sickness or death. It appears on the spike as one or several enlarged black or purple kernels and grows rapidly, reaching a length of a half inch and over. Like other spore diseases after reaching a certain stage of growth, fine dust-like material is given off which infects the remainder of the crop.

Change of seed and rotation of crops is recommended

whenever ergot is found. The grain secured from fields where ergot is noticeable should be thoroughly screened and graded before being used for feed or flour. Rye is subject to rust, but not to the same extent as wheat and oats. Little, if any, injury is experienced from insect enemies.

Fig. 56. — Rye head infected with ergot.

Rotation. — A rotation in which rye is grown one year out of four is preferable. The rye can follow peas, potatoes, corn, or any crop that is grown on sod. Grasses and clovers can be seeded with the rye crop to good advantage and hay can be cut for two succeeding years.

EXERCISES

1. Score samples of rye. The score card for rye is the same as that used for wheat and the directions for scoring rye are identical with those for wheat. (See pages 76–78.)

2. Outline the method of growing rye in your locality. Does the text suggest any means by which the local method may be improved?

HOME PROJECTS

1. Select a sheaf of rye and threshed samples for show purposes.

2. Grow an acre of select rye. Compare the yield and quality with that of an acre of common rye.

3. Find the cost of producing an acre of rye.

CHAPTER VIII

BUCKWHEAT

Buckwheat is not a true cereal but is usually classified as such by grain men. The name is of German origin and is probably a corruption of the German *buchweizen* which means beechwheat. The shape of the kernel of buckwheat resembles the beechnut, and the starch within the kernel resembles wheat starch, hence the name. Buckwheat belongs to the same family as the well-known bindweed, smartweed, knotweed, sorrel, and yellow dock. It may have been developed from one of the bindweeds, sometimes called wild buckwheat.

Varieties. — There are three distinct varieties: common buckwheat, notch-seeded buckwheat, and Siberian or Tartary buckwheat. The common buckwheat is the one of greatest importance. To this species belong the Silver Hull, the Japanese, and the common gray varieties. These are grown most extensively in this country. The Silver Hull seems to be most popular with millers, some of whom claim that it makes more and better flour than the other varieties. Some growers contend that the Japanese is a heavier yielder and will stand more sunshine and hot weather without injury than will the Silver Hull.

Habits of Growth. — The buckwheat seed puts forth but a single erect shoot which branches treelike above the ground and grows to a height of three feet. The root

growth is not extensive and consists of a main root with sufficient branches to hold the plant firmly in the ground and to secure adequate moisture and nourishment for its

Fig. 57. — Silver Hull buckwheat on left; Japanese buckwheat on right.

existence. It grows and gives returns on soil too poor for the growing of ordinary crops. Buckwheat responds readily to good treatment and by proper preparation of the seed bed and the use of manure the yield can be greatly increased.

Preparation of Seed Bed. — The land on which buckwheat is grown is usually plowed late in the spring, a few days before sowing. This method is not the best practice, however, as the soil should have ample time to settle before seeding. It is better to plow early in the spring and to run a fine-tooth harrow over the field at weekly intervals until seeding. Where late plowing is resorted to the roller and fine-tooth harrow should be used immediately after plowing, and again, after seeding for the purpose of compacting the soil, restoring capillary action through the soil, and pressing the soil particles closely around the seed to facilitate sprouting.

Sowing the Seed. — In northern latitudes the seed should be sown from May 20 to July 1 and at the rate of 3 pecks of Silver Hull or 4 pecks of the Japanese variety per acre. The seeds of the Japanese are larger, hence a heavier seeding is necessary to secure the same number of plants per acre. The late sowing of the buckwheat is done in order to carry the blossoming period beyond the hot winds and sunshine of July which are disastrous to the crop at the blossoming stage. Blossoms appear when the plant is partially grown and continue until the time of harvest.

Fig. 58. — A field of Silver Hull buckwheat in blossom.

Much of the green buckwheat ripens while the buckwheat is in the shock.

Harvesting and Threshing. — Buckwheat can be harvested with the binder but when so cut it should not be bound but laid off in unbound sheaves. For this purpose the old-fashioned self-rake reaper can be used to

advantage. After it has lain in the swath for a few days it can be bound loosely and set up in shocks. Usually it is not stored away in barns to go through the sweat but is hauled directly from the field to the threshing machine. An ordinary grain thresher is used, but it is supplied with blank concaves or concaves with all but two or three of the teeth removed, so that the buckwheat will not be hulled or damaged. After threshing, buckwheat should be stored in bins where it can be shoveled over to facilitate drying. Only good dry buckwheat can be used for flour.

Enemies. — Buckwheat is usually free from insects and disease enemies. It is a great weed destroyer and is known as one of our cleaning crops. It grows rapidly, and the many broad leaves shut out the sunlight, and make it almost impossible for weeds to thrive in the same field.

Uses. — Buckwheat is used in making pancake flour for human consumption and as a ground feed for farm animals. The straw is of little value except for bedding. Buckwheat is a prolific flowering plant and bees feed greedily upon it. The honey made from it is inferior to that made from white clover and is darker in color.

Rotation. — Little attention is paid to putting buckwheat in any definite rotation. It is usually sown on lands where other crops have been destroyed. Occasionally it is used merely as a cleaning crop on weedy lands or grown on hard soils and turned under to add humus to the soil.

EXERCISES

1. Judge samples of buckwheat. The score card and directions given for wheat may be used in judging buckwheat. (See pages 76–78.)

2. If Silver Hull buckwheat is sown at the rate of 40 pounds per acre, how many bushels of seed will it take to sow 40 acres of land? Buckwheat is estimated at 48 pounds per bushel.

3. If the buckwheat yields at the rate of fourteen bushels per acre and sells at $1.25 per hundredweight, how much will be received for the crop?

4. If, in milling buckwheat, one half of the total weight is flour, how much flour can be secured from the buckwheat grown from the above field?

HOME PROJECTS

1. Sow Silver Hull and Japanese buckwheat in separate plots to determine yield and desirability of each.

2. Grow buckwheat on land in which corn has been killed by flood or cutworms.

3. Grow buckwheat on newly cleared lands for the purpose of subduing the soil.

4. Grow a small plot of Silver Hull buckwheat for making buckwheat flour.

5. Grow both Japanese and Silver Hull buckwheat for seed.

CHAPTER IX

GRAIN BREEDING

Grain improvement may be brought about through selection and crossing. These methods are applied to the improvement of wheat, oats, barley, rye, buckwheat, and other grains; also to peas, beans, and forage plants.

Selection Method. — Foundation stock from the best-known varieties of grain grown is first secured. These varieties are sown in one-twentieth acre plots and the plants are studied during the growing period. The best heads from 100 or more plants are selected when mature, the kernels graded, and the heavy plump ones retained. These select kernels are sown the following year and the grains are again graded as before. By pursuing this method of selecting, the best grains for seed, oats, wheat, barley, and other small grains are greatly improved in quality and yield per acre.

Centgener Method. — A better method of breeding known as the centgener method is now used quite extensively by plant breeders. By this system a thousand kernels of the grain desired for foundation stock are used, and the individual kernels are planted 4 inches apart in the foundation or "mother" bed. Border rows are grown around the outside of the bed which are later discarded. Only the plants growing under uniform conditions inside of the border rows are retained. These plants are

studied during the growing period and those showing superior qualities are marked by placing a stick or a wire rod beside each. Twenty plants are usually selected from each bed. The heads are clipped from these plants and put into separate envelopes. The twenty envelopes each containing the progeny of individual plants are weighed separately, and the ten having the highest weight are retained, the lighter ones being discarded.

The second year the seeds in each of the ten selected envelopes are sown an equal distance apart in little square plots, known as centgener beds. A study of the plants is made during the growing period and the best heads from at least ten of the best plants are secured. These heads are placed in envelopes, the shrunken kernels being discarded, since only the best seeds are to be used for the following year.

The third year the process of the second year is repeated, and in the fourth year the entire yield of each of the ten

Fig. 59. — Two centgeners of wheat.

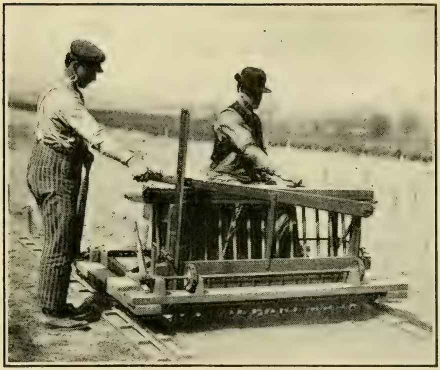

Fig. 60. — Planting with a centgener machine.

centgener plots is compared with that of each of the other nine, and the grain from the four plots in the test giving greatest yields is retained for increase plots.

In the fourth year sufficient seed is secured from the centgener plots to sow broadcast at least one square rod of each variety, after casting out light seed. These are called increase plots. From the increase plots sufficient seed is produced to sow a tenth of an acre from which the yield of grain is sufficient to seed one acre. An accurate record having been kept of this process for six successive years, the variety becomes a pedigreed variety.

Head-to-row Method. — This method is used extensively by plant improvers, and enables the operator to select in

Fig. 61. — Increase plots of different grains. Rows from single heads at extreme right.

the shortest possible time various plants that possess high yielding power and other desirable characteristics. It is a quick method of grain breeding by selection.

Land that is uniform in fertility must be used for the selection beds. The grain plants from which the heads are taken must be selected from fields or mother beds where

Fig. 62. — Head-to-row method of plant breeding. One head of wheat is planted in each row.

several thousand plants are grown under uniform conditions. Plants should not be selected from the edge of a field or some favored spot. From ten to a hundred plants especially noticeable for their desirable characteristics are selected from the various grain fields or plots, and the most desirable heads taken from each. These heads are shelled separately, placed in bottles or envelopes, numbered, and held until time for planting. The best progeny of a single seed from the previous year is thus retained.

The same number of seeds from each of the different heads are selected for planting each individual row. The seeds are planted the same distance apart in the row and the same space is left between the individual rows.

Fig. 63. — Crossing small grains.

This system of planting admits of easy comparison of individual plants of the same variety or of different varieties by simply comparing the rows.

The entire plot receives the same care and attention and is finally harvested, each row separately.

The rows are threshed and the yields from the individual rows determined. A few of the high yielding rows of the best quality are retained for increase plots, and the remainder cast out. The following year a comparative test for yield and desirable characteristics is made between the increase plots, and only those plots of grain that come up to the desired standard are retained for a field test.

The object of the breeder is to isolate single individual plants that have in them the power of perpetuating their

special characteristics of yield, quality, and vigor far in excess of other plants growing under similar conditions.

Crossing Method. — The crossing of plants consists in removing the stamens of the flower before they have fully matured, leaving the ovary to be fertilized by pollen taken from some other plant of the same species. Barley, wheat, and oats are "close fertilized" plants; that is, the stamens and pistils are borne on the same flower, which are so closely inclosed in its coverings that practically no pollen from other plants can reach the ovary of the flower. Hence, the same variety will breed true unless a cross is made by artificial means.

To obtain new strains of grains by crossing them, it becomes necessary to remove the stamens of the flower

Fig. 64. — Open flowers of wheat and oats, showing reproductive organs.

before they are far enough advanced to shed their pollen, and a few days later to introduce pollen from another plant.

This requires care and skill, as it is easy to injure the flower sufficiently to destroy its fertilization.

After the stamens are removed and the pollen from some other plant is introduced, the flower is again closed and covered with thin tissue paper to allow light to penetrate but to prevent the pollen of any other plant from entering.

Fig. 65. — Artificial fertilization.

Usually all except a small number of the flowers on the spike are removed, for more satisfactory results can be obtained when only a few of the flowers are used.

By this method of grain breeding, valuable new strains may be produced, but up to the present time it has not given as satisfactory results as the selection method. Crossing causes mixture of characters, many of which may be undesirable. Hence after crossing, it takes several years of straight selection to establish a desirable combination of characters.

Dissemination of Improved Grains. — After a grain is improved it is important to have the seed as widely disseminated as possible so as to test its value under varying conditions of soil and climate.

The aim of the grower of pedigree seeds is to get the entire community in which he resides interested in growing these grains instead of the common varieties. When their merits are known pedigree grains soon displace the numerous common varieties.

EXERCISES

1. Why must the crossing of pollen in small grains be done by hand?
2. How does this process differ from crossing in corn?
3. Why do crossed varieties tend to break up into several varieties?
4. How does the grain breeder prevent this breaking up of strains?
5. Which are most likely to come true to type, crossed or selected varieties? Why?

HOME PROJECT

On the home farm carry on a plot for the improvement of some grain or other useful plant, following directions given in this chapter.

CHAPTER X

LEGUMINOUS CROPS

LEGUMINOUS plants increase the fertility of the soil by adding nitrogen to it. If the roots of a legume are removed from the ground and closely examined, small swellings, or nodules, may be seen on them. In these nodules are bacteria that have the power of taking nitrogen from the air and of supplying it to the nodule-bearing plants. When the roots and nodules finally decay, the nitrogen that has been taken from the air is available for other crops that follow a leguminous crop. The most common legumes are the clovers, alfalfa, peas, field beans, soy beans, cowpeas, and vetches.

CLOVERS

The clovers are the most important group of leguminous plants. They not only add nitrogen to the soil, but also furnish a large amount of humus. They are great weed destroyers and are widely known as cleaning crops.

Common Red Clover. — The common red or June clover is the most generally grown of all clovers, and is of great importance to farmers living in the Northern States and Canada. It is said to be a biennial, the seed being sown one year and the crop maturing the following year. Under certain favorable conditions due either to the absence of severe freezing or to self-seeding the common red clover

may adopt a perennial character and produce crops for several consecutive years without reseeding.

Sowing the Seed. — Common red clover is usually sown in the spring with oats, barley, or spring wheat as a nurse crop, and at the rate of 5 to 6 quarts of clover seed per acre with one and a half bushels of grain. It should follow corn or some cultivated crop which has been grown on sod land. In places where it is difficult to get a catch of clover with a nurse crop, a cultivation for the killing of weeds from early spring to June 15 is practiced and the clover seed then sown without a nurse crop. If weeds appear, they are clipped back by running a mower over the field. The cutter bar of the mower should be run high, and the clippings if not too heavy should be left on the field for a mulch; if heavy, they should be raked off and burned. Under favorable conditions one cutting of hay or a good pasture can be secured the first year. If too wet, the fields should not be pastured. Clover is usually sown in mixture with timothy. When thus sown, 4 quarts of clover seed and 3 quarts of timothy seed are used per acre. If sown as a mixture, two cuttings of clover can be secured the year following seeding, the first of which is suitable for hay and the second either for hay or seed.

Fig. 66. — Common red clover.

Cutting Stage. — Clover should be cut for hay when it is in full bloom, and some of the early blossoms are turning brown. It should not be cut for seed until nearly all the heads are turned brown. If the second cutting is to be used for seed, it is well to take the first cutting of hay when only a few plants have come fully into blossom. For seed, the second cutting is preferable, as all the plants come into blossom uniformly, and bees and other insects that aid in pollination are more abundant at that time.

Cutting and Curing the Hay. — Clover should be cut when free from dew and rain, and left in the swath for a day to wilt. It may then be stirred with the tedder and after a few hours drying, raked into windrows, and put into medium-sized cocks. Every effort should be made to cure the hay without losing the leaves, which cannot be done if the clover is allowed to dry too long in the hot sun. The use of hay caps greatly facilitates curing. The evaporation

Fig. 67. — Curing clover. Note the size of the bunches.

of moisture goes on rapidly while in the cock and if left for two or three days, the hay will usually be well cured.

If all clover hay was carefully cured so that it would not

heat in the mow, much of the prejudice now prevalent against clover for horses would not exist. The high protein

Fig. 68. — A huller, used for separating the seed from clover.

content of clover makes it a valuable hay for dairy cows, sheep, and young stock.

Cutting for Seed. — As soon as the first blossoms turn brown, pick a dozen average heads, rub out in the hand, and count the seeds. The number of bushels of seed that can be secured per acre where the stand is fair, may be estimated by the average amount of seed found in a dozen or more heads. For each ten seeds found in each head, the field will yield one bushel per acre. For example, if the average is twenty seeds to each head, the yield will be two bushels per acre; if forty, four bushels per acre. This estimate is only approximate, as other factors, such as thickness of stand and thoroughness of hulling, have to be considered. When clover is harvested for seed a buncher attachment is used on the mower to bunch the clover and carry it out of the way of the next round of the mower.

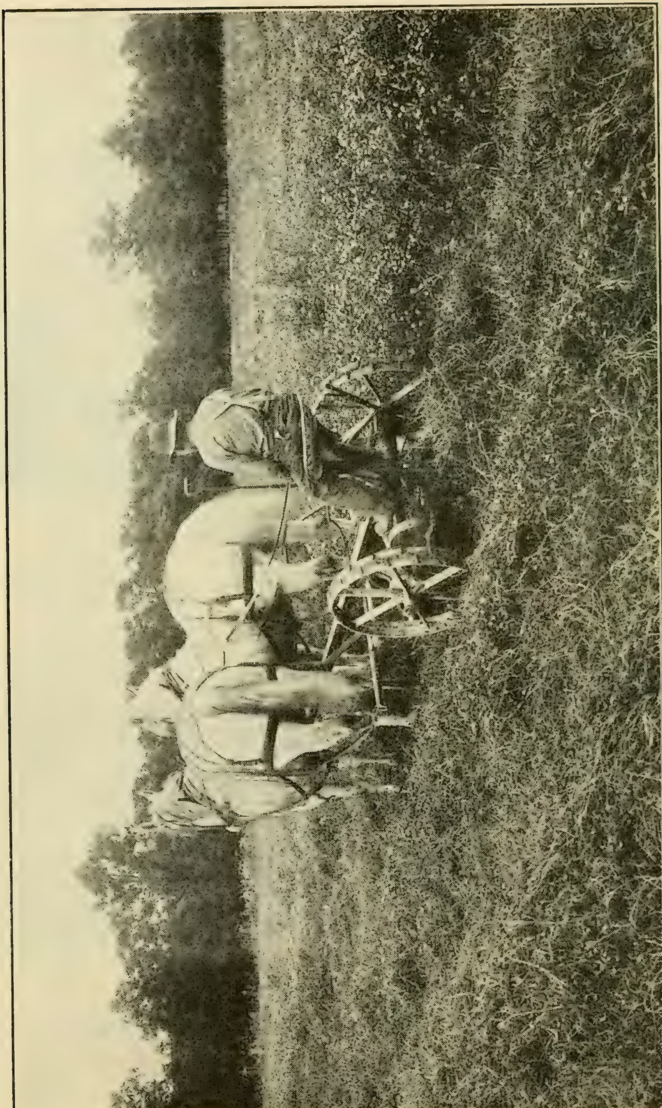

Fig. 69. — Cutting alsike clover.

After the clover has been left for three or four days or until thoroughly dry, it can be hauled direct to the huller, or stored or stacked, and hulled later in the season. The high price usually paid for good clover seed makes it a profitable crop for farmers to grow.

Clover produces seed best on clay land that has an abundance of lime in it. The seed should be run through a grader and screened before it is put on the market.

Mammoth Clover. — The mammoth clover resembles the common red clover, but under the same soil and climatic conditions grows ranker and taller. It is from two to three weeks later in maturing and makes a coarser hay. For this reason it is preferred on sandy and worn-out soils. On account of its lateness in maturing only one cutting of hay per season can be secured. If grown for seed it should be clipped back in the spring, when five or six inches high, and the clippings left for mulch. There is no way known to distinguish medium red clover seed from mammoth clover seed. Mammoth clover can be distinguished from the common variety by the later maturing of the mammoth and the absence of the white spot on the leaf, which is characteristic of the common red clover. The harvesting for hay and seed is the same for mammoth clover as for the common red variety.

Alsike Clover. — The alsike or Swedish clover is a perennial plant and is usually grown mixed with timothy or redtop, which aids in holding the stems erect. The alsike clover has a finer stem than the red clover and has a tendency to grow taller. It is later in maturing than the medium red and reaches the cutting stage about the same time that timothy and redtop do, which makes it an excellent combination with these grasses.

Alsike clover can be grown on land too low and wet for red clover. It can also be grown on high, well-drained lands or on any lands on which the red clover will grow. In harvesting for seed, it is clipped back in the spring to give it a uniform growth and blossoming period. The seed is much smaller than that of red clover. Much of it is used for dyeing purposes, and due to this constant demand, there is little variation in the price of this seed. The weight per bushel is the same for all clover seed. Alsike clover is a popular clover, not only for hay but for mixed pasture. When sown for seed, it should not be mixed with the grasses but should be sown alone at the rate of five quarts of seed per acre.

White Clover. — White clover is native to America and grows readily in all clover sections. The seed is of a yellow hue and smaller than the seed of alsike clover. White clover is perennial in nature and grows best on well-drained clay lands. When grown for hay, on account of its dwarf nature, it is always combined with the grasses so as to facilitate handling. The white clover seed is most used for pasture and lawn seed mixtures. When grown for seed, special devices for handling and hauling are necessary. Both alsike and white clover produce honey of the finest color and flavor. Beekeepers are most successful in districts where white and alsike clovers are grown abundantly.

VETCHES

The common, or smooth, vetch and the hairy vetch are the only kinds of vetches that are generally grown in the United States. Each of these kinds has both spring and fall strains. Vetches are used extensively in the South as

cover crops and soil improvers, and are becoming increasingly popular in the North.

Sowing the Seed. — In the Northern States the common vetch should be sown in early spring, alone or with oats or other spring grain as a nurse crop, using about one and a half bushels of seed per acre when sown alone, or from a half to one bushel of seed when sown with a nurse crop.

Fig. 70. — A field of vetch ready to be plowed under for the benefit of the soil.

The vetch seed can be mixed with the grain seeding and thus can be sown with a broadcast seeder or a grain drill, or it can be sown separately. If the vetch seed is sown alone, the seeder or drill can be adjusted so as to sow the proper amount.

In most sections of the United States the hairy vetch is sown in the late summer or early fall with rye as a nurse crop. The rye prevents sandy land from drifting and

affords protection for the tiny vetch plants. This combination crop furnishes excellent fall and winter pasture, and can be grazed down late in the spring without injury to the crop. After the stock is taken from the fields, the rye and vetch plants come on rapidly. The rye stems shooting up above the vetch plants, act as a support for them, thus keeping the vetch from trailing on the ground. The crop is harvested for hay much more readily than when grown alone. The hay cures much more easily and is of superior quality.

Uses. — Vetches can be grown for hay, for seed, as a pasture or soiling crop, as a cover crop in orchards, and as a soil improver. The vetches do not cure so easily as do the clovers and often have to be left in the cock for several days. It is good practice to use caps for the proper curing of the hay. When used as a soil improver, the winter vetch and rye are turned under in the spring after several inches of growth have been obtained, in time to use the ground for potatoes or corn.

Seed Production. — Most of the seed used for growing vetch in this country is imported from Europe. Since it does not seem to yield well in America, it has not as yet been produced here in large quantities. There are some localities near the Pacific Coast and in other parts of the United States, where considerable progress has been made in vetch seed production.

The seed is round and of a dark purple color, somewhat resembling a small pea. It also resembles the seed of the pernicious wheat cockle. The fields in which vetch is grown should be followed by a cultivated crop for at least two seasons before sowing small grains, thus preventing the mixture of small grains and vetch.

PEAS

Classification. — Peas are divided into field and garden groups. The garden varieties are used extensively as canning peas and are sometimes classified under that name.

Fig. 71. — A field of peas in blossom.

Each group has numerous varieties characterized by color, shape, growth of vines, or time of maturity. Among the field varieties may be mentioned the Scotch, Green, Yellow, Marrowfat, Early Puritan, and Prussian Blue. Chief among the canning varieties are the Alaska, Horsford, Admiral, and Advancer, each with its peculiar characters of identification.

Habits of Growth. — The pea puts forth but a single plant, but this plant divides above the ground and often several secondary branches may be found on a single stalk. The plants assume the nature of vines, which during the ripening period are recumbent and often lie prostrate upon the ground, making them somewhat difficult to harvest.

Location of the Seed Bed. —Peas do best on high, well-drained land that is well supplied with lime and organic

Fig. 72.—Mower harvesting peas, with buncher attachment at right.

matter. Best results are secured on the medium and heavy clay loam soils that do not heat to any great depth and are sufficiently rolling so that the surface water runs off rapidly. Peas do not do well on poor sandy soils or on lands that are low in fertility. On bottom lands and on rich prairie soils the vines grow so luxuriantly that they fail to fruit properly, thus producing low yields.

Sowing the Seed. — All seed should be tested previous to sowing and only seed of strong vitality should be used. Peas can be sown with the seeder or the drill and should be put in as soon as the ground works well in early spring. The drill is to be preferred for seeding as the grower is enabled to plant the peas at a uniform depth, thus covering all seed and encouraging uniform sprouting. Peas should be sown at the rate of from two to three and a half bushels per acre, and covered at a depth of two to five inches, depending upon the nature of the soil. On heavy clays that are

likely to bake, the peas should be put in at the lesser depth.

Harvesting and Threshing. — Special preparation should be given the land by plowing deeply in the fall and disking early in the spring. The growing of peas is greatly facilitated by rolling and dragging the ground before and after seeding in medium and light clay loams. This also prepares the land for harvesting. Peas are cut with a mower provided with buncher attachment or a pea harvester, and are left on the ground to cure.

Canning peas are harvested in the green state, by pulling up the plants, picking the pods from the vines and sacking them by hand, or by using a mower or a harvester for cutting the peas and leaving them on the field in convenient shape for handling. The pea vines are then taken to the factory and run through a machine known as a viner, which shells the peas, separates them from the vines, and runs them into the factory where they are graded and canned.

Another practice followed by canners is to have the grower deliver the peas ready shelled, for which they pay a certain price per pound. The canning of peas is a large and growing industry in the Northern States. The vines are used for silage or dried for pea straw and are greatly relished by farm animals.

Field peas when cut after ripening are left on the ground in bunches to cure before hauling in. After being fully cured they are hauled from the field and stacked or stored in barns to await the time of threshing.

Peas may be threshed with a special pea thresher or with the ordinary grain threshing machine. When the grain thresher is used the regular concaves of the machine are taken out and blank concaves put in their place to prevent the splitting of the peas.

Uses. — Canning or garden peas are used exclusively for human diet, while the field peas are used for both human food and for farm animals. The field peas sold on the market for human food are made up into various kinds of soups, while those used for animal food are usually mixed with oats, barley, wheat, or corn, and ground into meal.

Rotation. — Peas fit well into a rotation as a crop to be sown on sod land once in three or four years. The practice of growing peas for several successive years on the same land invites disease and multiplication of insect enemies, and is strongly condemned.

SOY BEANS

The soy bean is a native of southeastern Asia where it grows wild and forms an essential part of the food for the

Fig. 73. — A field of soy beans. Note the size of the leaves.

inhabitants. It was introduced early into Japan and is used there and in China principally as human food. Soy beans were introduced into the Southern States by the United States Department of Agriculture. Until recently

no extended effort has been made to grow soy beans in the North. They are classified as early, medium, and late, and each division has many varieties, based on color.

Habits of Growth. — In seed and general appearance the soy bean resembles the ordinary navy bean, especially in the early stages of growth. The common varieties are erect, bushy, and well-branched, ranging from eighteen inches to four feet in height. A covering of fine hair is noticeable over all parts of the plant. The leaves of the soy bean are composed of three large leaflets, borne on long leafstalks. The small flowers grow in clusters in the axils of the leaves. The short, hairy pods contain two or three round or slightly flattened seeds, varying in size from an eighth to a quarter of an inch in diameter. The plant has a short, strong taproot with a rather scanty root system. The soy bean is especially adapted to warm climates, but is more resistant to frost than corn, cowpeas, or field beans. The length of season required for maturing varies greatly with different varieties, ranging from 120 to 160 days. In the Northern States great care should be taken to get northern-grown seed of a variety that will mature in the grower's locality.

Fig. 74. — Early soy beans.

GROWING PERIOD AND YIELD PER ACRE OF SOY BEANS FROM TESTS MADE AT THE WISCONSIN STATION

Name of Variety	Growing Period in Days	Yield per Acre in Bushels	Weight per Measured Bushel
Ito San	136	33.7	56
Early Brown	136	16.5	56
Medium Early Black	133	14.3	54.5
Medium Early Green	155	22.3	56
Medium Early Yellow	136	39	54
Michigan Green	162	26.7	58
Wisconsin Black	122	23	54.5
Early Black	133	17.3	52

Uses. — The soy bean is not used as a human food in the United States, its chief uses being that of a hay plant, a soil renovator, a mixed silage crop, and a dry feed for hogs, sheep, and cattle. The protein content of this plant is so high when compared with that of other feeds that it commends itself readily to dairymen and stockmen who desire protein foods to use in balancing rations for farm animals.

The analyses of the seeds of dry soy beans show the following composition:

	Per Cent
Protein	36.25
Nitrogen-free Extract	25.97
Fat	16.90
Moisture	10.53
Ash	6.20
Crude Fiber	4.15
Total	100.00

As a hay crop it ranks next to alfalfa, and it makes excellent silage when mixed, at the time of filling the silo, with two thirds its weight of corn. If used exclusively for silage, it gives off a disagreeable odor that permeates the whole stable, and is therefore objectionable to dairymen for feed-

ing purposes. As the soy bean is an annual, a hay crop, superior to clover in feeding value, may be obtained in a single season. When drought occurs early in the spring and some other crop is ruined, soy beans may be planted as a catch crop, thus securing a good yield of hay or grain.

Soy Beans as a Protein Food. — The following table shows the relative amount of digestible nutrients in soy beans and in other common concentrated feeds. They rank closely with cottonseed meal and linseed meal and contain more than twice as much crude protein as wheat bran.

AVERAGE DIGESTIBLE NUTRIENTS IN SOY BEANS AND OTHER CONCENTRATES

Feeding Stuff	Total Dry Matter in 100 Pounds	Digestible Nutrients in 100 Pounds		
		Crude Protein	Carbo-hydrates	Fat
Soy beans	88.3	29.1	23.3	14.6
Cottonseed meal (choice)	92.6	35.8	23.2	8.0
Linseed meal (old process)	90.2	30.2	32.0	6.9
Wheat bran	88.1	11.9	42.0	2.5
Oats	89.6	8.8	49.2	4.3
Barley	89.2	8.4	65.3	1.6
Dent corn	89.4	7.8	66.8	4.3

The results of feeding trials at several experiment stations show the value of soy beans for various classes of animals. Being rich in crude protein they should never be fed alone but used with feeds, like corn, oats, and barley, which are much lower in crude protein.

Soy Beans for Hay. — The soy bean makes valuable hay when properly cured, and all farm animals eat it with great

relish. The following table shows the nutrients in soy bean hay compared with other common roughage:

AVERAGE DIGESTIBLE NUTRIENTS IN SOY BEAN HAY AND OTHER ROUGHAGE

Feeding Stuff	Total Dry Matter in 100 Pounds	Digestible Nutrients in 100 Pounds		
		Crude Protein	Carbo-hydrates	Fat
Soy bean hay	88.2	10.6	40.9	1.2
Alfalfa hay	91.9	10.5	40.5	0.9
Red clover hay	84.7	7.1	37.8	1.8
Oat hay	86.0	4.7	36.7	1.7
Timothy hay	86.8	2.8	42.4	1.3
Corn fodder with ears	57.8	2.5	34.6	1.2

Planting. — Soy beans thrive best on high, loamy soils but will grow on any soil that will produce potatoes or corn. The seed bed should be made fine and mellow. To mature the crop in northern sections, the soy beans should be planted in rows with a hand or grain drill after the time for planting corn. Approximately a third of a bushel of seed per acre is required when planted in drills. The rows should be about thirty inches apart and the beans should be dropped about two inches apart in the row.

When a heavy yield of dry beans or hay is desired, the early maturing varieties should be used. For silage purposes, the medium or late varieties are preferred. In growing soy beans for hay they should be sown broadcast or in narrow drills, using a bushel of seed per acre.

Cultivation. — Soy beans should be cultivated between the rows the same as corn and approximately at the same time. Usually three cultivations are sufficient, as the

broad leaves of the plants spread over the ground to such an extent that weeds are kept down effectually. They should not be cultivated while the leaves are wet with dew or rain, since this practice is likely to spread the spores of fungus diseases, and thus injure the crop. Shallow cultivation is highly recommended.

Harvesting. — For soiling purposes or for hay the plants should be cut with a mower when in blossom, but for seed

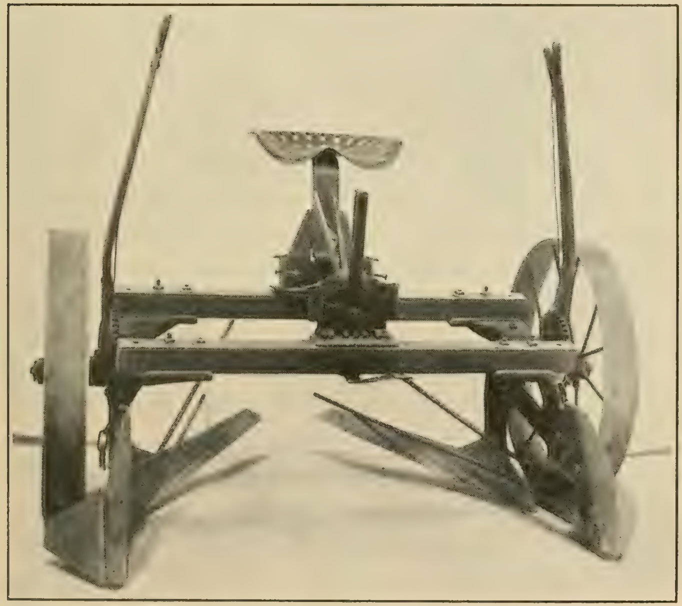

Fig. 75. — A soy bean harvester.

or dry beans they should be cut after the pods have turned brown. Soy beans can be harvested for seed with a common mower with windrow attachment or a bean harvester. Where only a small area is grown, they can be pulled by

hand or cut with a scythe or a corn knife. After cutting it is well to let the beans lie in shocks or in windrows for several days before threshing.

Threshing and Storing. — If the beans are thoroughly dry they can be threshed nicely with a grain thresher. Blank concaves should be used to prevent splitting of the beans. The cylinder should be run at less speed than when threshing grain. The beans should be stored in barrels or shallow bins, or spread out on a floor where from time to time they can be shoveled over until they are thoroughly dry and hard. Later they may be safely stored more compactly. When stored immediately after threshing, the beans are apt to heat and mold. As soy beans lose their germinating power rather quickly, even when properly stored, they should always be carefully tested for germination before planting.

The dry beans will keep well for several years when not exposed to the elements. They can be fed whole to pigs and sheep, but for general use it is preferable to crack or grind them.

Tests have shown that it is often necessary to mix the beans with corn or peas to grind them into meal, as the beans are too soft to granulate well if ground alone. Too large quantities should not be ground at a time, as the high oil content will cause the meal to heat and turn rancid in storage, making it unfit for feed.

Soil Inoculation. — When soy beans are planted on land that has never before grown soy beans, it is well to inoculate with the bacteria that produce the nodules on the roots of the plants. This can be done by securing soil from a field upon which soy beans have been grown for several years, and scattering it at the rate of about 600 pounds to the

acre upon the field to be planted with soy beans. A good inoculation can be obtained by merely mixing equal quantities of bacteria-laden earth and soy beans and planting the mixture. The roots of the plants on the land thus treated will be found to have the nodules attached to them in abundance, and the absence of the nodules will be noticed in plants from fields not inoculated. Tests seem to show that there are a limited number of the nitrogen-fixing bacteria for soy beans in all soils, but it is best to inoculate to secure at once their beneficial action.

Fig. 76. - Nodules on the roots of soy beans.

EXERCISES

1. What are the principal characteristics of the legumes?
2. How does the protein content of the legumes compare with that of cereal grains?
3. How do legumes benefit the soil?
4. Under what conditions will clover "wear out" the land?
5. What are the principal legumes grown in the Northern States? In the South?
6. Can a piece of land be inoculated for alfalfa by sowing clover on it?

7. By the use of the tables in this chapter calculate the amount of protein in a ton of alfalfa, clover, timothy hay, and corn fodder.

8. What is the average yield of each of the above crops in your locality?

HOME PROJECTS

1. Grow small plots of medium red, mammoth, crimson, and alsike clovers for comparison and study.

2. Sow common vetch in the spring with and without oats for hay, and cut when the vetch is in full bloom.

3. Sow hairy vetch in the fall with and without rye as a nurse crop, and note the development for hay the following summer.

4. Pasture vetch and rye in the fall and spring and then let grow for hay.

5. Turn vetch and rye under for green manure and grow corn, potatoes, or root crops, noting results.

6. Grow a plot each of Alaska, Admiral, Horsford, and Advancer peas for comparison and study.

7. Grow plots of Scotch, Marrowfat, Green, and Yellow field peas for comparison and study.

8. Put up some threshed and sheaf samples of legumes for exhibition purposes.

CHAPTER XI

ALFALFA

Alfalfa belongs to the legume family. Like other members of the family it is able to use the free nitrogen of the air to build up plant tissue, through the activity of certain bacteria that inhabit the nodules upon the roots. Alfalfa can truly be called the queen of forage plants. No other forage plant is more readily relished by farm animals or exercises a more beneficial effect upon the soil. There are numerous varieties of alfalfa, differing in their foliage, manner of growth, and ability to withstand the elements. The leading varieties are the Grimm, Cossack, Baltic, Turkestan, Common Persian, and Sand Lucerne.

Habits of Growth. — Alfalfa is an erect plant and grows to the average height of two to three feet. It is characterized by smooth stems and leaves and the numerous shoots coming forth from a single plant. The alfalfa plant has a large taproot and many smaller branch roots or several distinct roots running down from a single crown. In many instances the roots penetrate the ground to a depth of twenty-five feet. A veritable forest of roots lies under each well-established alfalfa field. Alfalfa through this large root growth exerts a beneficial effect upon the soil on which it grows; and through its power to feed on the soil elements and secure moisture at great depth below the surface, it is able to stand severe droughts and maintain

itself upon the soil for many years without the necessity of reseeding.

Through this power of the plant to send down such a vast number of roots the soil even though previously compact becomes porous and friable, so that in later years when

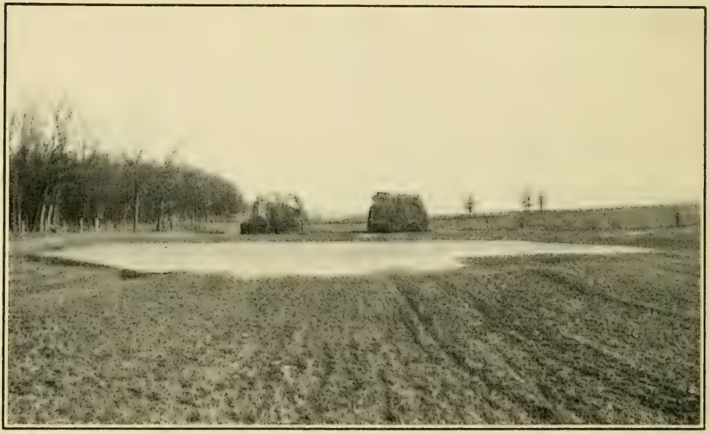

Fig. 77. — Alfalfa should not be grown in a poorly drained field.

plowed and fitted for other crops its physical condition is much improved. This great mass of root growth which decays when the field is plowed up adds materially to the humus content and the richness of the soil, and thus enables the farmer to have a field high in fertility in which he can grow large crops of corn or other grains.

Location and Preparation of the Seed Bed. — The alfalfa field should be located on high, well-drained land. In humid regions it is useless to sow alfalfa seed on river or creek bottoms that overflow their banks annually, or to sow it on marsh lands where the water level is only two or three feet below the surface. It is also well not to select a

field so level that the surface water cannot run off readily after showers and heavy rains. On level lands in winter when melting snow or rain fills the small depressions, ice may form over these shallow basins and smother the plants. Alfalfa can be grown on nearly all soils, but does best on gravelly or limestone soils where the surface soil is a clay loam. It is extremely hard to get a catch of alfalfa on sandy soils unless the land is heavily manured and given special treatment. Heavy clay lands will grow alfalfa to advantage if the ground is plowed deep and thoroughly pulverized. A soil that has grown grain and hay crops through a series of years and has been thoroughly subdued is best suited for alfalfa growing. Fall plowing is to be preferred, as a beneficial influence is exerted on the soil by the winter freezing. If spring plowing is resorted to, the ground should be rolled and dragged before and after seeding.

Fig. 78. — Preparing the seed bed for alfalfa.

Fall-plowed land should be disked in early spring and immediately dragged with a fine-tooth harrow. It should then be kept mellow with the harrow until the time for seeding.

Testing the Seed. — Alfalfa seed should be tested before planting, as the test will reveal to the farmer several facts which will guide him in his work. Before purchasing alfalfa seed in large quantities, farmers should write to their seedsmen requesting samples of seed. A simple plate tester is used in making the germinating test. This tester is made by using two tin pie plates, one slightly smaller than the

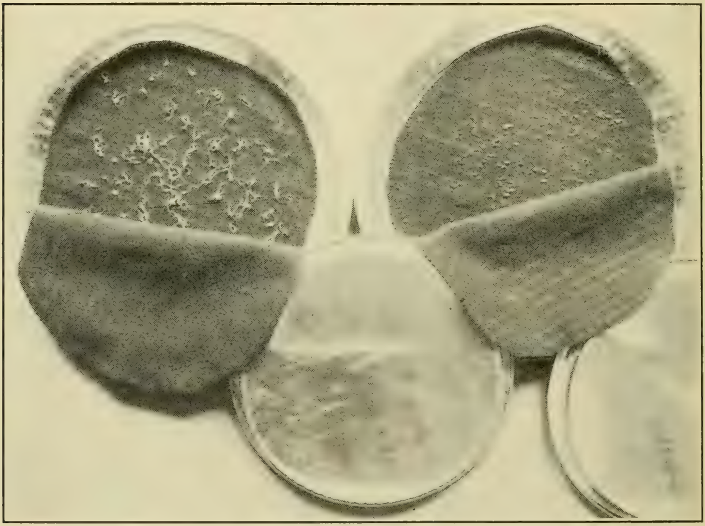

Fig. 79. — Pie-plate testers for alfalfa and grass seeds.

other. Earthen plates can be used, but they are not so convenient and are liable to be broken. Cotton or flannel pads are cut out the same size as the inside of the under plate. The pads are soaked in water and then squeezed to remove the surplus water. One pad is put at the bottom of the larger plate and a hundred alfalfa seeds are placed upon it. The other pad is placed upon the seeds and the smaller plate inverted and used as a cover to prevent

evaporation of moisture. Common blotting paper can be used for pads if desired. The tester should then be left in some convenient place at ordinary room temperature (70° F.) or slightly above. At the expiration of twenty-four hours the tester is examined, and if the pads are somewhat dry, they should be moistened. The lower pad should be raised when these examinations are made so as to admit air underneath the pad, which facilitates the process of germination. Seeds should show signs of germination after being in the tester for seventy-two hours. All good seeds under favorable conditions will have sprouted after being in the tester five days. Those not sprouted at this time may be rejected as worthless, but should be kept at least twenty-four hours beyond the usual time so as to leave no doubt as to the reliability of the results. As the seeds sprout they should be taken from the tester from day to day and a record made of the test on a slip of paper that may be kept on top of the pads. In making these tests the vigor shown in the sprouting of the seeds should be taken into consideration as well as the number of seeds sprouted. A seed that is tardy in germinating and puts forth a weak sprout is not desirable. Occasionally hard seeds are found in alfalfa that seem impervious to moisture and consequently will not germinate in the allotted time, but will germinate, however, in the ground after frost has acted upon them, or if they have been scratched by passing through a seeder. It is customary for seed laboratories to count a third of all hard seeds found in a test as germinable.

Sowing without a Nurse Crop.—In the early spring the disk should be run over the land and followed with a fine-tooth harrow at weekly intervals until about June 1, so that the weeds will sprout and be killed. This treatment

will conserve moisture and warm the soil. The alfalfa seed is then sown without any nurse crop, using twenty pounds of seed per acre. If the land is known to be weedy, it is best to continue the cultivation through June and a portion of July and then sow the seed. If conditions are favorable and seed is sown June 1, one cutting of alfalfa hay may be secured the same season. Alfalfa can be cut with safety any time previous to the first appearance of frost. In the Northern States the last cutting of alfalfa should be made not later than September 10, regardless of the cutting stage. Sufficient growth will then be secured before freezing weather to protect the plant through the winter.

The practice of sowing alfalfa with a nurse crop is being displaced by the method of sowing the seed alone, and much better results are obtained if the land is free from weeds. The tiny alfalfa plants should have a chance to take full possession of the ground, which they cannot do to advantage if crowded by a nurse crop. While experiments show that good catches of alfalfa are occasionally secured by the use of a light nurse crop, yet much better catches and a more lasting seeding can be secured by sowing the alfalfa seed alone. The seed can be sown either with a hand seeder or a grain drill with a grass seeder attachment. When sown with a hand seeder, or when broadcasted with a seeder attachment, a slant-tooth harrow should be used to cover the seed slightly.

On clay soils the seed should be sown less than an inch deep, or the tiny plants will not be able to push their way to the surface. Land plowed in the spring for alfalfa should be dragged as soon as plowed to prevent drying out and the planker or roller should be run over the land before and after seeding, and finished by using a fine-tooth harrow

so as to leave the surface loose enough to prevent rapid evaporation. The alfalfa crop is benefited by a light coating of well-rotted manure, or manure that is free from coarse litter. It should be put on during a dry spell or after the ground is frozen in the fall so as not to injure the plants when driving over them.

Fig. 80. — A six-year-old alfalfa plant.

Sowing with a Nurse Crop. — If one wishes to grow a grain crop the same season that alfalfa is seeded, much care should be taken in the preparation of the seed bed. If the land has previously grown alfalfa, it will be much easier to get a good stand than if it is the first seeding. Experiments show that on rich soil, barley is one of the best nurse crops, although oats or spring wheat may be used. The nurse crop should be sown thin, using only about half

as much seed as when the cereal crop is sown alone. When alfalfa is sown with a nurse crop, the time of seeding should be governed by the best time for the cereal. The seeding can be done with one operation provided a drill or seeder is used with a grass seeder attachment. It is preferable to let the alfalfa seed scatter broadcast and to run a slant-tooth harrow over the ground once after seeding. Some good seedings have been obtained when the seed was run through the drill, but the tendency is to cover too deeply when this practice is followed. If the season is extremely dry, it is best to cut the nurse crop early for hay and thereby give the alfalfa a better opportunity to grow. If the season is not too dry, the cereal crop can be left to ripen, and can be harvested in the usual manner. Many good stands of alfalfa have been secured in this way.

Fig. 81. - Alfalfa plant in blossom.

Other Methods of Seeding. — If the land is mellow and conditions are favorable for the growth of alfalfa, a stand can be obtained by sowing the seed early in the spring on land that is growing fall rye. When the land is extremely weedy, it is advisable to summer fallow and sow alfalfa the first week in August. The moisture conserved makes the alfalfa seed sprout rapidly, and the plants reach sufficient height for winter protection. Often where early peas or potatoes have been grown, the land can be put into

condition and alfalfa seed sown after the crop of potatoes or peas has been harvested. If weedy, the land should be plowed after the crop is removed; and to kill weeds, a fine-tooth harrow should be run over it at intervals through the latter part of the summer and early fall. Alfalfa can then be sown without a nurse crop in the early spring with probability of a good catch. Alfalfa can be sown successfully on rich soils, following early crops such as peas, early potatoes, and early grain crops.

Cutting and Curing Alfalfa. — No crop can be secured the same season that alfalfa seed is sown, except under the

Fig. 82. — Cutting a field of alfalfa.

most favorable conditions. The year following seeding, three good crops may be expected. The first crop in northern latitudes will be ready for cutting early in June, a trying time for curing hay. It should be cut when the alfalfa is in advanced bud and a few plants are in blossom, on a day that promises fair weather. Occasionally the alfalfa will come into bud and hesitate to blossom; sprouts will then immediately start at the base. It should be cut

when those conditions prevail even though no blossoms appear.

When alfalfa is cut in the morning, if the weather is favorable the hay can be raked and put into small cocks in the afternoon of the same day. The cocks should not be left standing in the field more than two or three days during wet weather without moving, or the alfalfa plants underneath the cocks will be partially or completely smothered. By running a pitchfork into a cock of alfalfa near the bottom one can easily move the pile. If alfalfa is exceedingly green when cocked, or rainy weather sets in, it will heat unless the cocks are opened every day or two. In favorable weather no more difficulty will be experienced

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Fig. 83. — Hogs fattened on alfalfa.

in curing alfalfa than in curing heavy growths of clover. Like clover leaves, the alfalfa leaves drop off readily when dry. As the leaves are richest in nitrogen the aim of the farmer should be to cure the alfalfa with the least possible

handling. Half of the feeding value may be lost through weathering and improper handling.

Curing under Caps. — A much better quality of hay will be secured if the crop is cured under hay caps than in

Fig. 84. — Alfalfa under hay caps.

open cocks or windrows, as dew and sunshine hurt alfalfa hay. Caps can be made from light cotton duck. The edges of the cloth should be hemmed to prevent raveling and eyelets should be made in the corners, in which strings may be tied and attached to weights. Heavy wires eighteen inches long and looped at one end to receive the strings attached to the caps make a convenient arrangement to hold the caps in place. These wire pegs can be either run into the ground or bent in the form of hooks and pushed into the sides of the cocks.

Much of the feeding value is lost through stacking, as the hay is porous and rain penetrates the stacks two or three feet. However, little of the alfalfa is lost when stored under cover. An outside mow with roof does fairly well, or a covering of marsh hay or a tarpaulin will prevent damage to the alfalfa in the stack. It is well to let the

alfalfa sweat in the cock, otherwise it will heat and get musty in the barn or stack.

Alfalfa as a Soiling and Pasture Crop. — No other soiling crop will give such good results throughout the summer as alfalfa. Alfalfa is ready to cut for soiling about June 1, and can be cut continuously until September 5 in the North and earlier and later in the South. By beginning to cut early and arranging so that daily cuttings can be taken through the advanced cutting state, it is possible to have good succulent alfalfa throughout the summer. In good growing weather a crop will mature sufficiently for soiling purposes in twenty to thirty days. Alfalfa has not yet come into general use in the East as a pasture crop. The attempts so far made have proved disastrous to the crop. There is no doubt that it makes an excellent pasture, but stock relish the plant so much that they graze it too closely. Only a limited number of animals should be turned in, so that the fields may be pastured and cut for hay also. As a hog pasture, no plant can excel alfalfa. Ten to twelve medium sized hogs can be pastured on an acre. The surplus alfalfa in the hog pasture when mature should be cut and made into hay. Ruminants, such as cattle and sheep, often bloat when allowed to pasture on luxuriant growths of moist alfalfa, but there is no such danger after the alfalfa is in blossom and during dry weather.

Seed Production. — Very little seed has as yet been produced in the humid regions and we are dependent upon the arid and semiarid districts of the United States for our alfalfa seed production. The larger portion of the seed is grown under methods of irrigation where six or eight hay crops are produced annually. As a crop of seed is secured

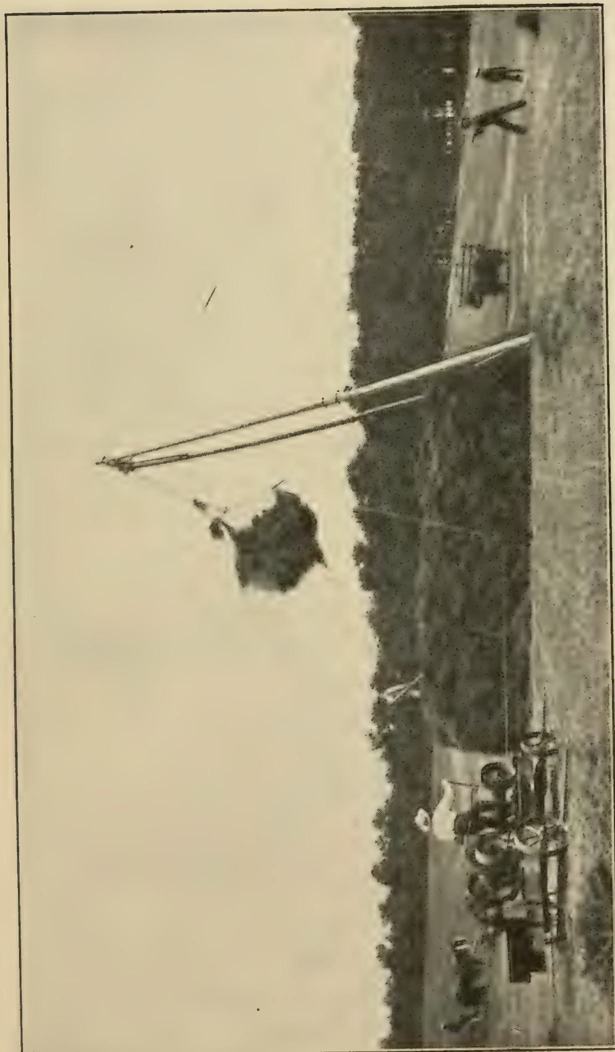

Fig. 85. Stacking alfalfa with a power stacker. The stack will, when finished, be topped with tarpaulin or a fine grass.

at the expense of two cuttings of hay, it will not pay the grower in the East to produce seed until larger yields per acre can be secured.

Alfalfa Acreage. — The great amount of valuable forage taken from a limited acreage has led many to think that a large portion of the farm should be sown in alfalfa regardless of condition. A word of caution to farmers who have never grown alfalfa is necessary. They should try only a limited acreage, not more than one or two acres to begin with, for the purpose of studying the plant and the soil conditions on the farm. The longer alfalfa is grown and fed upon the farm the more ideal the conditions for successful growth become, and the day is rapidly approaching when alfalfa will be grown as generally in the humid regions as common red clover now is.

Soil Inoculation. — Alfalfa is able to use the nitrogen of the air, only when the nitrogen-fixing bacteria are present. Where the soil contains these organisms in limited numbers the plants not acted upon by the bacteria soon wither and die. In some sections the ground is sufficiently supplied with the alfalfa bacteria, but there are localities where they are present in so limited numbers that it seems impossible to get a catch of alfalfa that will survive the first winter. Sweet clover, an ordinary roadside weed, is one of the distributors of alfalfa bacteria. When a farmer is in doubt as to whether his land contains the proper bacteria he can successfully inoculate his fields by scattering on them soil from an old alfalfa field or soil on which sweet clover has grown. For best results one ton of earth per acre should be scattered immediately preceding the sowing of the alfalfa seed. Farmers who have no alfalfa or sweet clover near at hand from which to get infected soil in large amounts,

should secure a sack of a hundred pounds of alfalfa soil from some alfalfa grower or from the state experiment station. One hundred pounds of this soil is sufficient to scatter on about eight or ten square rods of the field to be sown in alfalfa. The year following the seeding, soil can be taken from the portion of the field on which the infected soil was scattered and used for the inoculation of larger areas. Alfalfa responds readily to these methods of inoculation, and nearly all plants will have the proper nodules on the roots the first season of growth. If the infected soil is mixed with the alfalfa seed and sown by hand, a small amount of soil will partially inoculate a considerable area.

Fig. 86. Clusters of nodules on alfalfa roots.

To prepare soil for growing alfalfa a mixture of one fourth alfalfa and three fourths clover or grass seed may be used in seeding down a portion of the farm. The mixed hay will be improved by the alfalfa in it, and the alfalfa plants will become producers and distributors of the bacteria needed for future crops of this legume. After alfalfa has been grown and fed, and the manure made from the alfalfa scattered over the farm, all the soil on the

farm soon becomes filled with the proper germs. Where exceedingly heavy applications of barnyard manure are placed upon small areas, the alfalfa does well, and in the second year of its growth has the proper nodules even without artificial inoculation. The United States Department of Agriculture, some of the colleges of agriculture,

Fig. 87. Scattering bacteria-laden soil for inoculation purposes previous to sowing alfalfa seed.

and several commercial firms are now preparing artificial cultures which readily take the place of soil for inoculating purposes.

Rotation. — No definite rotation of crops is practiced by farmers in general. When a field of alfalfa is well established the desire is to continue cutting as long as the field will furnish good crops. When alfalfa can be grown successfully on all portions of a farm a five-year rotation can be maintained, in which alfalfa can be grown for three years and grain crops for the other two years. This practice will result in better yields of grain crops.

Feeding Value of Alfalfa. — The feeding value of alfalfa

in comparison with that of other forage crops is shown in Table A. The value of alfalfa hay in comparison with that of common grain feeds is shown in Table B.

TABLE A. FEEDING VALUE OF CURED HAY

(Digestible nutrients in 100 pounds)

Cured Hay	Pounds Protein	Pounds Carbohydrates	Pounds Fat
Alfalfa hay	11.7	40.9	1.0
Red clover	7.1	37.8	1.8
Alsike clover	8.4	39.7	1.1
Orchard grass	4.9	42.4	1.4
Mixed grasses	4.2	42.0	1.3
Timothy	2.8	42.4	1.3
Redtop	4.8	46.9	1.0
Barley hay	5.7	43.6	1.0
Kentucky blue grass	4.4	40.2	0.7
Oat hay	4.7	36.7	1.7
Fodder corn	2.5	34.6	1.2
Corn stover	1.4	31.2	0.7

TABLE B. COMPARISON OF GRAIN FEEDS WITH ALFALFA HAY

(Digestible nutrients in 100 pounds)

Feeds	Pounds Protein	Pounds Carbohydrates	Pounds Fat
Alfalfa hay	11.7	40.9	1.0
Wheat bran (spring)	11.9	42.0	2.5
Kernel corn	7.8	66.8	1.0
Corn meal	6.7	64.3	4.3
Oats	10.0	50.3	3.5
Barley	8.4	65.3	1.6
Wheat	8.8	67.5	1.5
Buckwheat	8.1	48.2	3.8

Correcting Acid Soils for Alfalfa. — The natural home for alfalfa is on limestone soils or other soils that are well supplied with lime. No matter how favorable other conditions may be, if the soil is sour, it will be necessary to neutralize the acidity before it will be possible to obtain good results.

Acid land can occasionally be detected by plants such as sheep sorrel, horsetails, and mosses that thrive on it. It can always be determined by testing it with blue litmus paper in the following manner. Take some moist earth from a few inches beneath the surface of the ground and press it firmly over a strip of blue litmus paper. Do not handle the litmus paper when the hands are moist as the perspiration from them may cause the paper to show an acid reaction when no acid is present in the soil. After the paper has remained in the soil for ten or fifteen minutes, the litmus will change in color from a blue to a pink or red, if the soil is acid. This acidity must be corrected before alfalfa can be grown to advantage.

Acidity can be corrected either through the application of pulverized limestone, dry marl, or slaked lime. The best results seem to be obtained by the use of limestone or marl. No evil results follow their use as is occasionally the case with caustic lime. Over an acre of ground there should be scattered two to three tons of pulverized raw limestone or one to two tons of marl. Heavy applications of barnyard manure seem to benefit most acid soil sufficiently to get a catch of alfalfa. After alfalfa has become well established on land high in fertility it seems to thrive even on acid soils. The application of lime has a beneficial effect on leguminous plants other than merely correcting the acidity of the soil.

Enemies and Diseases. — Like most plants alfalfa has its enemies and diseases which are troublesome under certain conditions in some sections. Alfalfa dodder, a parasitic plant which twines itself around the alfalfa plant and lives upon its juices, often ruins fields of alfalfa. The dodder seed is nearly the same size and color as the alfalfa seed and is not readily noticed. When alfalfa seed comes from infested fields it is contaminated with this pest. If sown with the alfalfa seed, the dodder will not be noticed until discovered in the growing field. When considerable areas of the field are found to be infested it is best to plow the field and run to corn or grain crops for a series of two or three years before reseeding to alfalfa. Many of the states now have seed inspection laws and a penalty is attached to selling seed contaminated with mustard, dodder, buckhorn, and other obnoxious weed seeds.

In seed-producing sections leaf spot is quite common, and often the crop is materially reduced or entirely ruined. When leaf spot, mildew, or rust makes its appearance it is best to cut the crop at once for hay. The succeeding crop may be entirely free from these diseases.

Gophers and prairie dogs often injure fields of alfalfa by burrowing in the ground and eating the alfalfa roots. Trapping and poisoning the animals seem to be most effective. Blister beetles, army worms, and grasshoppers are destructive at times.

EXERCISES

1. If a 20-acre field is seeded at the rate of 16 pounds of alfalfa seed per acre and the seed costs 20 cents per pound, what is the cost of the necessary seed?

2. Bring to school for class use specimens of nodule-bearing roots of sweet clover, red clover, and alfalfa.

HOME PROJECTS

1. Establish a plot of alfalfa containing four square rods in the following manner. Select well-drained soil suited to the alfalfa plant. When ready for seeding after the soil has been prepared according to directions given in this chapter, spread over this plot, distributing as evenly as possible, about fifty pounds of finely divided air-slaked lime and harrow it in thoroughly. Just before seeding, inoculate the soil with about the same amount of alfalfa or sweet clover soil and harrow immediately. The plot is then ready for seeding in the regular way.

2. Sow alfalfa seed with and without a nurse crop.

3. Sow alfalfa seed after removing an early crop from the land.

4. Sow alfalfa seed with and without soil inoculation.

5. Mix a quart of alfalfa seed per acre with grass or clover seed to establish alfalfa plants as bacteria distributors.

CHAPTER XII

THE HAY GRASSES

Most of the hay and pasture crops are either legumes or grasses. Clover and alfalfa are legumes although they are sometimes spoken of as grass crops. The chief hay plants that, in a strict botanical sense, belong to the grass family are timothy, Kentucky blue grass, brome grass, orchard grass, and redtop.

TIMOTHY

Of all the hay grasses grown under cultivation, timothy ranks first and brings the best prices on the market. Its clean leaves and stems and the readiness with which it cures without injury after cutting has made it a desirable hay for feeding horses.

Varieties. — No distinct varieties of timothy are as yet found upon the market and it was not until quite recently that any attempt had been made to breed definite strains.

Testing the Seeds. — All timothy seed should be tested for germination before sowing, and unless the germination runs 80 per cent or higher, the seed should be regarded with suspicion. Seeds that have retained the hulls are supposed to be superior to the hulled seeds as it is believed that they retain moisture and withstand adverse conditions better. Experimental data seem to show that it makes little difference in the results whether the seed is naked or inclosed within the hull.

Sowing the Seed. — Timothy should be grown in a four-year or five-year rotation, in which the plan is to get a hay crop in the third year and another in the fourth year. It is usually sown in connection with clover, using about four quarts of clover seed and three quarts of timothy seed per acre. This mixture is sown with barley, oats, or wheat as a nurse crop. If the seasons are favorable, the first year after seeding two cuttings of clover hay can be secured, and a crop of timothy for hay or seed can be obtained the next year. The third year a crop of hay can be harvested or the field can be pastured. If the field is left to timothy for two years, the fifth year the ground should be plowed and planted in corn, potatoes, peas, or beans. The land should be heavily manured if run to timothy two years, as the timothy crop makes a heavy draft on soil fertility. It is much better practice to grow timothy in a four-year rotation in which only one crop of hay or seed is taken in the four-year period. The usual practice is to sow the seed in the spring, but it may be sown in the fall with wheat or rye. If sown quite early in the fall, it usually withstands the winters and the clover can be sown on the growing crop in early spring. A grass seeder attachment to a grain drill or a broadcast seeder is commonly used for grass seeding where the ground is in proper condition for the use of farm machinery. On newly cleared and rocky lands a hand or wheelbarrow seeder

Fig. 88. — A timothy plant at the cutting stage.

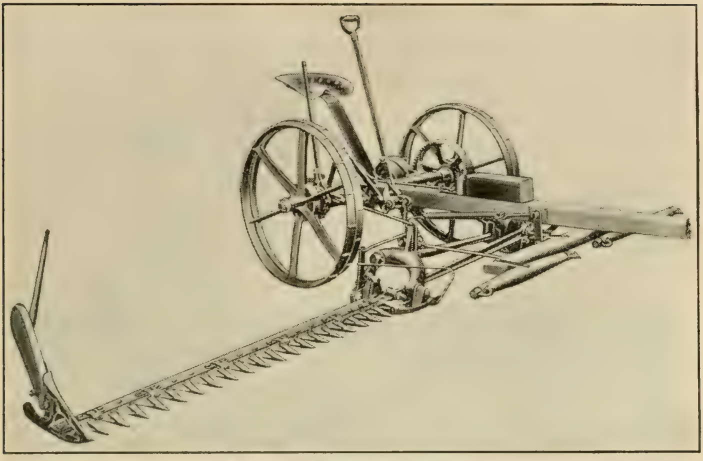

Fig. 89. — A mowing machine.

may be used to advantage. The legal weight of timothy seed in most states is 45 pounds per bushel.

Cutting and Curing the Hay. — For best results timothy should be cut when it has passed its first bloom. If cut in the bloom, it is apt to be somewhat dusty. Timothy is easy to cure and should be tedded the afternoon of the day

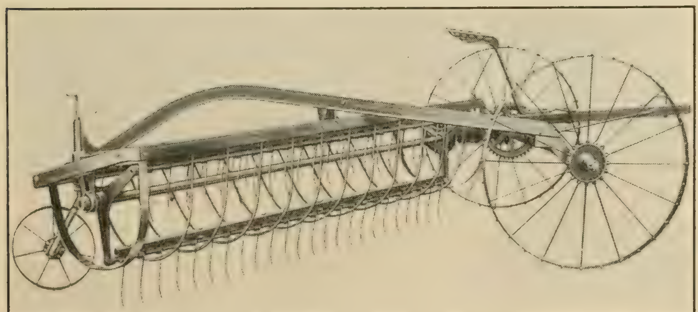

Fig. 90. — A side-delivery rake.

when cut or the day after and raked into windrows and put into medium-sized cocks. If left in the cocks for two or three days, it goes through a sweat and will not heat or

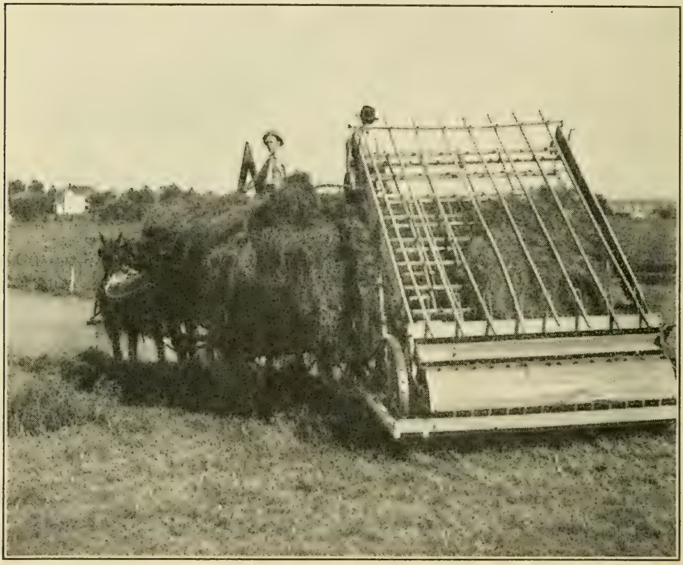

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Fig. 91. — A modern hay loader.

mold when put into the mow. Where large acreages of timothy are grown for hay the hay loader may be used to advantage a day or two after cutting. A side-delivery rake is an excellent piece of farm machinery for raking up the hay in convenient form for the use of the hay loader. The hay may be stacked, but a much better practice is to store it away in large barns or sheds.

Marketing the Hay. — The most convenient way to market the hay is to bale the hay direct from the mow and at a convenient time haul it to market. Timothy and wild hay are marketed loose when sold to local markets where

there are stables and lofts for storing it away. Timothy is occasionally baled direct from the field, but on account of its being only partially cured and not having gone through the sweat it is liable to heat and mold; so this method is not considered good practice. Where hay is sold from the farm the farmer is wise to sell his timothy and retain his clover, especially for feeding cows, sheep, and young stock. To keep up the fertility of the farm the farmer should plan to use more clover and less timothy.

Pasturing. — Timothy is a rapid grower and the grass is relished by all farm animals especially in the spring and fall. If pastured lightly, it is good practice to run over the pasture in midsummer with the mower, taking off the surplus hay. When this practice is followed the fall pasture is very much improved. If a permanent pasture is desired, Kentucky blue grass, alsike clover, and redtop seed should be mixed in equal parts by weight with the timothy seed

Fig. 92. — A timothy pasture after cutting off the hay.

before sowing. When harvested for seed it can be readily cut with a grain harvester, placed in shocks, and threshed with a grain thresher.

Habits of Growth. — The erectness of the plant is one of its strong characteristics and one of the reasons for the good quality of its hay. It seldom lodges, and if carried down by a severe storm, it soon regains its erect position. The plant usually grows three to four feet in height, and in a fertile soil it may reach the height of five feet. The root growth is strong and vigorous and makes a firm sod, especially when mixed with blue grass. The sod rots readily and the root growth is thus converted into humus. Timothy exerts a heavy draft upon the soil without returning any fertility to the land except that portion retained in the root growth.

Fig. 93. — Kentucky blue grass.

KENTUCKY BLUE GRASS

Kentucky blue grass, or June grass, is the best pasture grass of the United States, and is used extensively over a large area of the country. Like all of our native grasses it is perennial in character. When a field is once seeded to blue grass a permanent pasture may be retained for many years without reseeding.

Sowing the Seed. — Blue grass is usually sown with timothy or some other erect grass when the plan is to cut it for hay. If seeded alone, it usually bends over and lies so closely to the ground that it is hard to mow and to handle after being cut. When it is grown in combination with other grasses it is kept erect and the ripening is so

Fig. 94. — A Kentucky blue grass pasture. The blue grass furnishes excellent pasturage for horses and cattle.

retarded that it can be secured at the proper cutting stage with the other grasses. It grows so close to the ground that it forms a thick mat after two or three years and gradually crowds out the other grasses. Blue grass grows so extensively in uncultivated fields and pastures and so fills the land with seed that when the fields are sown to clover and other grasses it often comes on voluntarily and is soon quite noticeable.

Harvesting the Seed. — The larger portion of the Kentucky blue grass seed is grown in Kentucky. It is harvested as soon as the heads and stems turn yellow. The seed is stripped from the plants by special machinery for that purpose. These strippings are put in windrows and left to cure. The windrows should be stirred frequently while curing. If the heads become heated, the germinating power of the seed is injured. After the heads are thoroughly cured they are run through special machinery which takes out the seed and cleans it for market. The germination of Kentucky blue grass seed is low even when good care is taken in harvesting and curing it. A test of 60 per cent to 65 per cent is considered exceptionally good. The yield of well-cleaned seed weighing 24 pounds per bushel is approximately 100 pounds per acre. When left in the chaff the yield runs somewhat higher.

Uses. — Blue grass is a great pasture and lawn grass and is grown for that purpose more than for hay. It will grow in the shade better than any of our grazing grasses and is consequently used much in open wood lot pastures. When used in combination with other grass seeds for pasture or hay about ten or twelve pounds of seed is sown per acre. When used alone for lawn or golf grounds it is sown frequently at the rate of forty to fifty pounds of seed per

acre. For lawns a mixture of 30 pounds of Kentucky blue grass, 15 pounds of redtop and 6 pounds of white clover per acre is recommended. Blue grass does best in a medium clay loam that is well supplied with humus and lime. It does not do well in semiarid regions or on exceedingly heavy clay or light sand.

BROME GRASS

Brome grass was introduced into the United States from Europe and is now grown quite generally on the Great Plains, where timothy and blue grass do not thrive. It has been grown for centuries on the plains of Russia and is there regarded with great favor. It roots deeply, consequently stands drought well, and makes an excellent early spring and late fall pasture. It is not considered so good for hay as timothy and will not become popular in those states in which timothy, clover, and blue grass can be readily grown.

Sowing the Seed. — Brome grass is usually sown in the spring like timothy, blue grass, or redtop, using about twenty pounds of seed per acre when sown alone, or about eight pounds when sown with a grass mixture. It may, like timothy, be sown with early seeding of fall rye or winter wheat. If sown in the fall under favorable conditions, it makes a good pasture the next fall.

The temptation to sow brome grass on fields infested with quack grass, and then harvest it for seed, has been the cause of much of the brome grass seed becoming contaminated with quack grass seed. Farmers purchasing brome grass seed should see that it is free from such contamination. When there is doubt as to its purity, it is best to send a sample for inspection to the seed-testing department of

the state experiment station or to the United States Department of Agriculture.

Harvesting. — Brome grass grows from four to five feet tall and stands erect, so that if desired for seed, it can be cut and bound with a grain harvester. It should stand in the shock until dry and then be stored away in barns like grain or brought direct from the field to the thresher. Like timothy it is threshed readily with a grain thresher.

Brome grass should be cut for hay when in blossom. It cures well and is handled the same as other hay grasses. Its feeding value compares favorably with that of timothy. After cutting, if moisture is sufficient, it grows up so as to furnish excellent fall pasture. It is not readily injured through pasturing, as it forms a very heavy sod. Brome grass fields are greatly helped by disking deeply after the second crop of hay has been removed. When brome grass is grown for hay it is well to grow it in a four-year rotation like timothy, planting corn or some other cultivated crop on the brome grass sod. On account of the numerous rootstocks in the ground it requires a sharp plow and much power to break the sod. Unless the sod is turned completely over the numerous roots are apt to send up new shoots.

ORCHARD GRASS

Orchard grass is not grown so generally as timothy or blue grass in the United States. It is raised most abundantly in the states south of the blue grass and timothy regions. It is also becoming quite extensively grown in the Pacific States.

Orchard grass grows two to three feet tall and is readily recognized by its smooth stems and by the panicles which consist of one-sided clusters on top of the branching stems.

Uses. — Orchard grass is grown for hay, seed, and pasture. As a hay crop it is inferior to timothy and redtop, but ranks well as a pasture grass for early spring and late fall. It does not spread by rootstocks nor does it branch or stool out strongly. It grows in bunches or tufts and does not cover the ground completely like redtop, timothy, or blue grass, hence the lower yields of hay per acre and the necessity of reseeding more often.


Fig. 95. — Orchard grass.

Sowing the Seed. — The weight of orchard grass seed varies from fourteen to twenty-two pounds per measured bushel, depending on how closely it is graded. From a bushel to one and a half bushels of seed per acre should be used when sown alone or about one fourth bushel when sown as a mixture. When desired for seed it is left to ripen, and is cut and bound, like timothy, with a harvester. After it has been well cured in the shock or mow, it is threshed with a grain thresher, especially arranged with proper screens for threshing grass seed. Kentucky is the leading state in the production of orchard grass seed.

REDTOP

Redtop, a perennial grass, is a native of the United States and grows wild over an extensive area. As a hay crop it ranks closely with timothy and blue grass. It gives good yields on undrained lands that are too low and wet

for the production of timothy or blue grass. It will do better on acid soils than any of our other hay grasses. Redtop is an erect plant, about three feet in height. The root growth is shallow but branching, which enables it to make a dense sod that covers the entire surface of the ground.

Sowing the Seed. — When sown for a meadow about twenty pounds of clean seed should be used per acre. In a grass mixture of timothy and alsike clover it is well to use 10 pounds of redtop, 5 pounds of timothy, and 5 pounds of alsike clover. On low, undrained lands redtop and alsike clover should be sown in combination, as the hay or pasture will be of better quality and relished more by farm animals if grown as a mixture. The seed, if free from chaff, can be handled by a grass seeder. When sowing redtop seed mixed with chaff, better results will be secured if the sowing is done by hand.

Harvesting. — Redtop reaches the cutting stage about two or three weeks later than blue grass or common red clover. When grown in combination with alsike clover, they both reach the proper cutting stage for hay at the same time. Redtop is cut with a mower and cured the same as timothy. It cures readily and sheds water well when stacked.

HOME PROJECTS

1. Prepare sheaves of grasses, clover, and alfalfa for show purposes in the following manner. Collect tall, healthy, leafy samples having medium-sized stems, and cure slowly in a dark room or shady place where free circulation of air can be obtained without a strong draft. Do not pile the plants too thickly or the leaves will turn yellow or red and may mold. Stirring will

also help to cure them properly. Put up neatly in bundles or sheaves about three or four inches in diameter at the base. Tie these bundles with a strong cord. Do not use wide ribbons or binder twine. For the timothy and blue grass samples choose large heads and long stems and strip off the leaves of each stalk before making the sheaf. With alfalfa and clover the dry leaves may drop off in handling. This may be prevented by covering your samples with a damp cloth for a short time before making up the sheaf, but do not get your samples too damp. Collect the clover when in blossom, the alfalfa when just beginning to bloom, and timothy and other grasses when the heads have passed the blossoming stage. Prepare two or more sheaves for your county fair or other grain shows.

2. Grow a plot of timothy seeded at the rate of 6 quarts per acre. For comparison, also a plot of clover and timothy mixture, sown at the rate of 4 quarts of timothy and 2 quarts of clover.

3. Prepare samples of clover seed and timothy seed for exhibition purposes.

CHAPTER XIII

POTATOES

The potato is an American plant, and was introduced into European countries soon after the discovery of America. In Europe potatoes did not readily find acceptance, but the American colonists regarded them with more favor, and cultivated them to a considerable extent. Ireland was the first of the European countries to realize the importance of the potato crop and grow it on an extensive scale. The potato became so common in Ireland that it is now generally known as the Irish potato to distinguish it from the southern sweet potato.

Classification. — Potatoes are divided into two great classes commonly known as early and late potatoes. In each class are numerous varieties. Seedsmen have used the term " variety " in a careless way. Many of the so-called varieties are the same kind of potatoes. The introduction of many varieties has been more of a hindrance than a help to the advancement of potato culture. Often several types of potatoes are grown on the same farm, and in the same hill, or row. Mixed varieties of potatoes do not sell well on the market. Among the standard varieties that are now receiving much attention are the following: Early: Early Ohio, Early Rose, Bliss-Triumph, and Irish Cobbler. Late: Rural New Yorker, Green Mountain, Burbank, and Peerless.

The period of growth of the early potatoes varies from 70 to 100 days, while the late sorts require from 110 to 130 days for maturity.

Except those grown for special purposes, where extra prices can be secured, the late potatoes are more popular and are grown more widely for the market.

Habits of Growth. — The tuber is not the true potato seed although it is frequently spoken of as such. The true

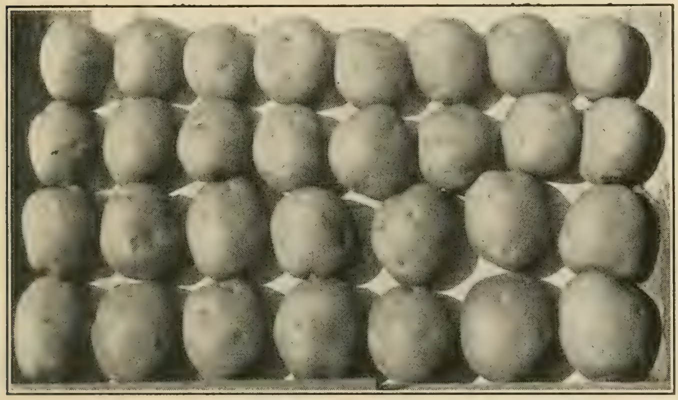

Fig. 96. — Rural New Yorker potatoes. This is a late variety.

seeds of the potato are contained in the potato ball which is found on the top of the plant following the blossoming period. When the desire is to establish new varieties the true seed is used. The potatoes grown from the true seed often differ widely in shape, size, and color from the tubers grown on the plant from which the seed ball is taken. It requires several years of patient selection to develop a good type of potatoes grown from seed.

Potatoes do not mix or cross, but will hold firmly to the original breed of the foundation stock of tubers. The

variety may be modified by selection and by the condition under which they are grown, but the type remains the same. The blossom of the potato may be cross-fertilized, but this does not appear in any way to affect the tuber; however, the true seed or potato ball is materially affected and these seeds if planted will not reproduce the variety of potatoes from which they are taken.

Uses. — The chief use of potatoes is for human food. A considerable quantity is used for the manufacture of starch, potato flour, animal food, and alcohol, when the price of potatoes is sufficiently low to admit of their use for such purposes. Large potato centers often use the small or irregular potatoes that are not suited for market for starch and alcohol. The European countries utilize their potato crops to much better advantage and with less waste than the United States. When the market price of potatoes is low farmers make use of them for the feeding of farm animals.

All farm animals including poultry relish potatoes. They can be fed raw to advantage to all animals except poultry and hogs. For these they should be cooked.

Storing for Seed. — It is important to keep seed potatoes in a cool cellar so as to prevent sprouting, for if allowed to sprout much plant food is removed and the vitality is materially reduced. If the windows and doors leading to the potatoes in storage are left open during the night and closed during the day after warm weather arrives the arrangement will assist in keeping the cellar cool. If the potatoes have sprouted, the sprouts should be removed before planting.

Planting. — The tubers used for seed are usually cut before planting. The cutting is often done by hand. Machines

are now used for cutting where large quantities of seed are needed for planting. Potatoes are planted in hills or in drills. Hills are placed approximately three or three and a half feet apart and seed dropped at the rate of two or three pieces to the hill. The drill method is now used generally where large acreages are planted. When planted in drills the pieces are dropped twelve to fourteen inches apart in the row and the rows are usually three or three and a half feet apart. This distance admits of the best use of modern machinery for planting, cultivating, spraying, and digging. From twelve to fifteen bushels of seed are required per acre for a good stand. Only good sound seed should be planted.

Immediately after planting, the fine-tooth harrow should be run over the field and continued at intervals in order

Fig. 97. — Preparation of the seed bed by harrowing and rolling. The potato planter is at the left.

to sprout weed seeds. The harrow can be used to advantage even after the potatoes are above ground, providing it is done in the afternoon of a fair day when the plants are not so brittle as when filled with moisture.

Seed Bed. — Potatoes may be grown on any fertile, well-drained soil, but do best on a rich sandy loam,

abundantly supplied with humus. A young clover field in which a second cutting of clover has been turned under in the fall offers fine conditions for potato planting the following season. If land is plowed in the early fall and left in the rough during the winter, it can readily be put in good tilth by disking in the spring. The fine-tooth harrow should be run at weekly intervals after disking to prevent baking, loss of moisture, and for the purpose of killing weeds. A deep, mellow seed bed well supplied with fertility is essential for large yields of good-sized potatoes. Potatoes should not be planted on heavy clay lands that are not properly drained and filled with humus. Light sandy soil, low in fertility and humus content, should also be avoided.

The plowing under of clover or vetch with the heavy application of barnyard manure will soon enable one to grow potatoes to advantage on light, sandy soil or on the heavy clays, provided the drainage is good. One should never attempt to grow potatoes on creek or river bottoms that overflow periodically, or on marsh land where the ground-water line is only a few feet beneath the surface. Peaty marsh lands should be avoided as they lack uniformity in character and the soil is too loose. The land should be uniform in tilth and fertility in order to assure an even growth and a good yield.

Diseases. — Chief among the diseases that affect potatoes may be mentioned early and late blight, scab, and black leg.

Both early and late blight in their first stages affect the leaves of the plants and later the stems and tubers. These diseases are controlled by spraying at intervals with Bordeaux mixture. This mixture is made as follows: dissolve 5 pounds of high-grade stone lime in 50 gallons of

water. In another cask containing 50 gallons of water suspend 5 pounds of copper sulphate (blue vitriol) in a

Fig. 98. Potatoes sprayed for prevention of blight on right. Potatoes not sprayed on left.

gunny sack and place just beneath the surface until dissolved. When well dissolved the lime and the copper sulphate solutions should be mixed. This is best done if the solutions are taken in pailfuls from each cask alternately and put into a third. It is well to test the solution to determine its effect upon the leaves of the plants. This can be done by putting a bright knife blade into the solution. If the blade remains bright the solution will not injure the plants, but if the blade takes on a coppery hue more lime should be added. The lime prevents the copper sulphate solution from injuring the plants. It should then be put into a spraying machine and sprayed on the plants in the form of a fine mist. It requires about fifty gallons of

the mixture to spray one acre. Spraying with Bordeaux mixture may also control other fungus diseases not fully understood at the present time.

Potato scab is a disease that affects the potato externally, making ugly blotches upon the surface. The disease is carried by the germs which remain upon the seed potato or are left in the ground, thus affecting the succeeding crop. The scab disease lives in the ground for several years. After scabby potatoes have been grown on a piece of land, no more potatoes should be grown on this piece for at least six years.

Where potatoes have become affected with scab the grower should secure seed potatoes that are free from this disease, or treat the affected ones by submerging sacks of the potatoes for two hours in a solution made by adding one pint of formaldehyde to 30 gallons of water. Other treatments may be used, but the formaldehyde is most simple and effective. Whole potatoes should be treated and cut for seed after treatment. If potatoes so treated are planted on scab-free ground the disease will not be found on the succeeding crop.

Insect enemies. — The Colorado beetle, more commonly known as the potato bug, is the chief insect enemy. Other insect enemies that do more or less damage are the flea beetle, blister beetle, and grasshopper.

For control of potato insects, arsenical poisons are used. Paris green and arsenate of lead are the poisons commonly applied. A Paris green solution is made by placing 2 pounds of standard Paris green in 50 gallons of water. If sprayed on the potato plants after the dew has dried off in the morning on a day that promises fair, the first batch of insects will usually be controlled. It is often neces-

sary to use a second application a week or two after the first one. If rain follows within a few hours after the first application it is best to respray at once. Paris green may be added to the Bordeaux mixture and the potatoes can thereby be sprayed for the prevention of blight and insects at the same time.

Instead of Paris green, arsenate of lead may be added to the Bordeaux mixture at the rate of 3 pounds to 50 gallons

Fig. 99. — A Wisconsin potato field. Note the quantity of potatoes.

of the solution. The arsenate of lead sticks to the potato leaves better than does Paris green, particularly in damp weather.

Harvesting. — Potatoes should be harvested when in proper condition for marketing or storing away for winter use. The proper condition is indicated by the drying up of the vines. The vines of ripe potatoes when pulled free themselves from the tubers. Unripe potatoes adhere

quite firmly to the stalks. The skin or outside covering of the potato will rub off readily if not properly matured.

Fig. 100 Hill selection of seed potatoes. The hills piled separately are to be used for seed.

and the potato will not be firm and crisp when cut. In order to keep well in storage potatoes should be fully matured.

Where potatoes are grown on a commercial scale they are harvested by machinery. Several good potato diggers are now on the market. Potatoes should be allowed to dry off before being stored or taken to the market. This is done by putting them in piles where they can be aired. They should not be left on the ground subject to strong sunlight or dew, but should be covered lightly with straw or dry potato vines.

Storing Potatoes. — Potatoes are stored in cellars or warehouses in which they can be kept at a low temperature, about 34° to 40° Fahrenheit. Often they are put in pits and if properly cared for, come through the winter in

excellent shape. Whether potatoes are put in pits or stored in cellars, provision should be made for proper ventilation or they will deteriorate rapidly. Potatoes should be carefully sorted and the small and damaged ones should be rejected before storing or marketing.

Potato Improvement. — It has been found advantageous for a whole community to grow one standard potato instead of several varieties, as a better price can be obtained from one straight grade than if mixed shipments are made. The proper marketing of potatoes is very essential to the success of the growers.

Much improvement is being brought about through careful work with distinct varieties. By intensive selection

Fig. 101. — Green Mountain potatoes after improvement by two years of hill selection.

of seed potatoes for type and disease resistance, a good standard marketable potato can soon be established. Such a potato can well take the place of the mixed types now so often found in many communities.

Hill Selection. — The method of improvement known as hill selection is conducted in the following manner. Single potatoes are cut and the pieces from one potato only are planted in a single hill. During the growing period the characteristic vine growth is studied carefully and any hills that show disease or improper vine growth are marked and discarded. The hills showing uniform, healthy growth are left to ripen and are harvested separately. There will

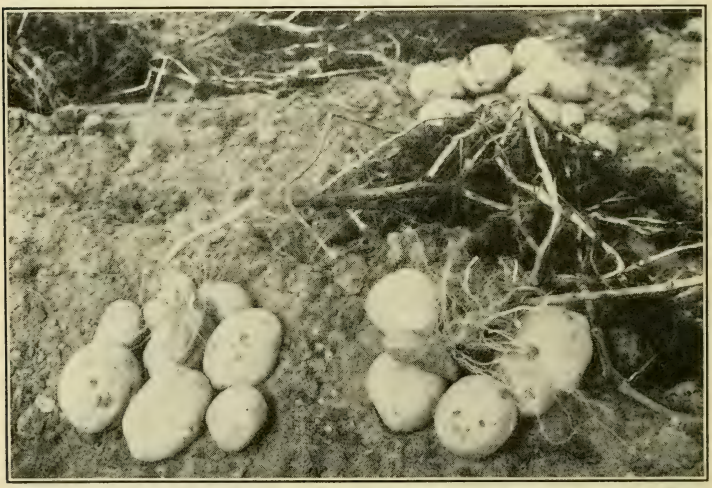

Fig. 102. — Only hills that produce uniform size potatoes should be used for seed.

be a wide variation of the productive power of the individual potatoes used as seed. The hills of potatoes showing large yield of uniform potatoes should be placed in separate piles. In this manner a few hills can be selected that have much higher powers of production than the average. This method may be carried forward for several years until a high yielding standard strain of potatoes has been developed. Quality as well as quantity is considered in hill selection.

SCORING POTATOES

1. Judge samples of potatoes, using the following score card and directions for scoring.

POTATO SCORE CARD

NAME AND NUMBER OF SCORER. . . . .
SAMPLE NUMBER. . . . . .DATE. . . . .

		1	2	3	4	5	6	7	8	9	10
1. Trueness to breed type	20										
2. Uniformity in regard to size	10										
3. Conformity in regard to shape	10										
4. Eyes shallow . . .	10										
5. Freedom from scab and other diseases	15										
6. Freedom from injuries	15										
7. Percentage of food to waste	10										
8. Texture of tuber .	10										
Total	100										

DIRECTIONS FOR SCORING POTATOES

1. If the potato does not look like the type called for in the name of the sample or if it is some other kind of potato, cut 20 points.

2. The best seed potatoes should weigh about as follows, in ounces:

Early Ohio	4 to 8	Rural New Yorker .	8 to 12
Triumph	3 to 8	Peerless	6 to 10
Early Rose	6 to 16	Irish Cobbler . . .	5 to 8
Burbank	6 to 12	Green Mountain . .	8 to 12

Cut 1 point for each half ounce below the lesser weight and 1 point for each half ounce above the greater weight.

3. Cut 1 to 5 points according to degree of poor form.

4. The eyes of the potato should be shallow in all potatoes listed under No. 2 except possibly in the case of the Triumph and the Irish Cobbler. They generally have rather deep eyes. In case of Triumph and Irish Cobbler potatoes cut .25 of a point for every deep eye. In case of all other potatoes listed under No. 2 cut .5 point for every deep eye.

5. Cut 15 points for any disease seen on a tuber.

6. Cut 15 points for any injury such as a bad bruise, a severe cut or hole punched by any apparatus used in digging, or for generally peeled-up skin of tuber.

7. Cut 1 to 5 points according to the amount of tuber that would probably have to be wasted in careful paring.

Fig. 103. — Green Mountain potatoes. First prize winning sample on right; second, on left.

8. Only in extreme cases is it necessary to cut open potatoes to determine prizes. Allow full scores for texture unless a tuber has to be cut open. If the potato is cut open and a

hollow spot is found, cut 10 points. If the potato is spongy or if dark streaks run through it, cut 1 to 5 points.

Fig. 104. — A boys' potato-growing contest.

The above rules are for choice seed or prize exhibits. In case of market potato exhibits one should be a little more lenient in cutting the scores.

EXERCISES

1. What varieties of potatoes are grown in your locality?
2. Why is a rich sandy or light loam soil best for potatoes?
3. What kind of hills should be selected for seed?

HOME PROJECTS

1. Select potatoes for seed, first by marking desirable hills while the vines are green, next by saving the most desirable of these marked hills at digging time.

2. Grow a plot of potatoes, keeping an accurate record of cost of production.

CHAPTER XIV

COTTON

THE first introduction of cotton into the American colonies was probably made in Jamestown, Virginia. By 1780 it had become one of the important products of South Carolina. The invention of the cotton gin by Eli Whitney in 1793 led to an enormous increase in cotton production.

Characteristics of the Plant. — As grown in the United States, the cotton plant is generally erect, somewhat bushy, and usually from two to six feet tall. In its native home, the tropics, it is a perennial, but in this country it is an annual, being easily killed by frost. The longest branches of the plant are usually near the base and in most varieties the length of the limbs gradually decreases toward the top of the main stem, giving to the plant a more or less conical shape. Productiveness and earliness are indicated largely by the arrangement of the branches. This is also an important means of distinguishing the varieties. There is wide variation in the size and shape of leaves and this also aids in distinguishing the varieties.

The cotton plant has a strong branching root that penetrates deep into the soil. However, the depth of penetration is modified greatly by the nature of the soil and subsoil in which the plant is grown.

If cross-fertilization takes place it must be during the short time that the flower is open. With some varieties the flowers open at sunrise, close late in the day and never

open again. The petals of upland cotton are white or creamy in color; those of Sea Island cotton are bright yellow. During the day they turn pink or bright red.

The portion of the plant containing the seed and lint is called the boll, which usually has four or five divisions.

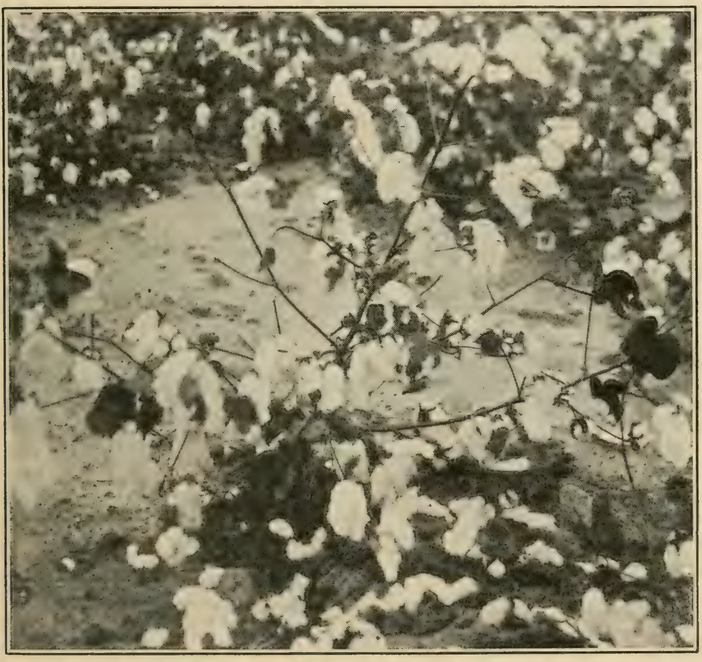

Fig. 105. — A typical cotton plant bearing cotton ready to be picked.

The bolls vary greatly in size, depending upon the varieties. Usually they are from one and a half to two and a half inches in length and from one to one and a half inches in diameter. The big-boll varieties average from 40 to 70 bolls per pound of seed cotton and the small-boll varieties from 80 to 130 per pound.

The Fiber. — There is but little twist in immature fiber, and based upon the amount of twisting, there are in every lot of cotton three kinds of fibers, — mature, partly mature, and immature. The strength of cloth and thread depends largely upon the amount of twist or state of maturity of

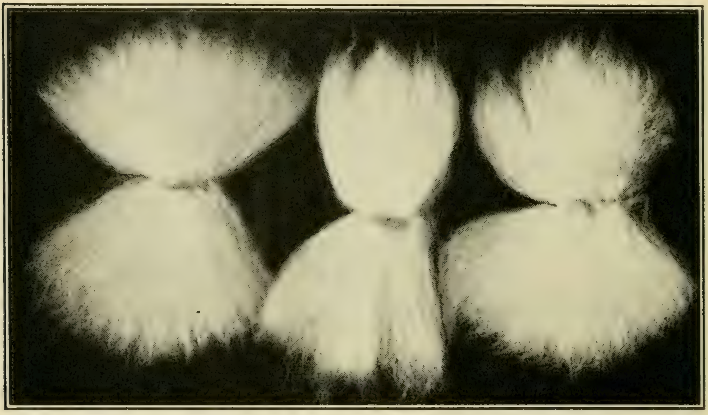

Fig. 106. — A fine grade of cotton fiber.

the fiber. The more mature the fibers are, the more uniformly and satisfactorily will they absorb the dyes used in the manufacture of colored cloth.

The following factors generally determine the value of cotton fiber: (1) strength, (2) length, (3) fineness, (4) maturity, (5) uniformity. Usually the longest fibers are the finest and these are used in the manufacture of the more expensive cotton fabrics. The following are about the average lengths of the fibers of the principal kinds of cotton:

American upland	.9 inch
American long staple	1.3 inches
Egyptian	1.4 inches
Sea Island	1.6 inches

The Seed. — In each division of the boll there is a lock of cotton, which contains six to twelve seeds, making about 25 to 40 seeds in one boll. The number of seeds depends largely upon the variety, as some varieties have much larger seeds than others. The color of the seeds varies from white to blue, depending largely upon the variety. In most varieties of upland cotton, the seed is covered with fuzz. In some of the long-staple varieties, the seed is practically free from fuzz and is generally black

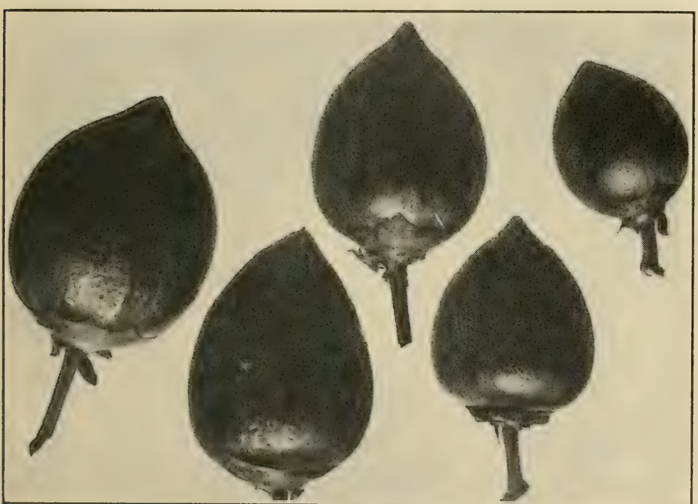

Fig. 107. — Cotton bolls at various stages of growth.

in color. The legal weight of a bushel of seed in most states is 32 pounds.

Varieties. — Cotton grown in the United States may be classified into three groups: 1. upland cotton; 2. Sea Island cotton; 3. Egyptian cotton. The first group constitutes about 99 per cent of the cotton produced in the

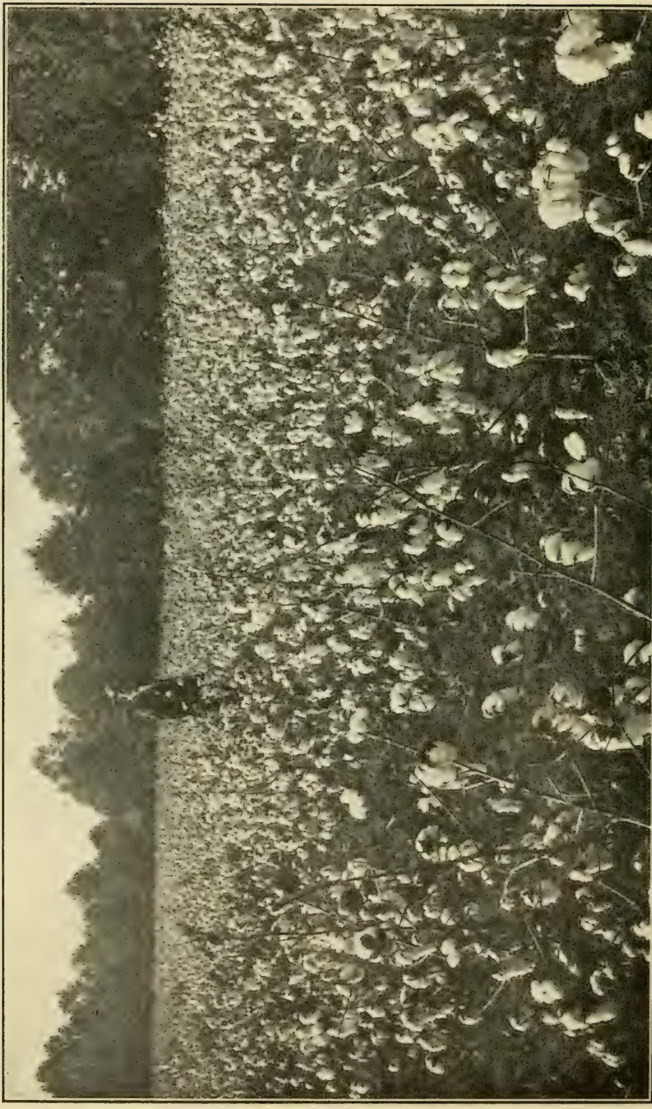

Fig. 108. — A field of cotton ready for the pickers. Estimated yield of fiber, 500 pounds per acre.

United States. This group includes both the long-staple and short-staple varieties.

The second group, or Sea Island cotton, is grown only in limited areas, in South Carolina, Georgia, and Florida. It is considered a profitable crop only within a distance of about 100 miles of the coast. The fiber is long, fine, and silky. It is considered the best fiber produced and sells for the highest market price.

The third group, Egyptian cotton, includes the leading varieties now grown in Egypt. The fiber of this cotton is somewhat longer than that of the American upland long staple, but is shorter and less valuable than that of Sea Island. During recent years, experiments have been conducted in practically all the cotton-growing states with this variety. It is not considered a profitable crop except within very limited areas. In the southern parts of Arizona and California where the growing season is long and where irrigation is practiced, this cotton usually gives very good yields and produces a fiber equal to that imported.

Cotton Breeding. — Cotton breeding has received little attention in the cotton belt. The low yields of cotton in the South are not due to poor soils and unfavorable climatic conditions alone, but principally to the planting of unimproved seed. A large proportion of the farmers of the cotton belt do not practice seed selection, consequently the seed of this crop is impure, mixed, and in other respects inferior. Pure varieties, with ordinary usage, usually "run out" within a few years. This is due to a lack of seed selection, to cross-fertilization, and to the mixing of seed at public cotton gins.

With proper selection and breeding, any of the following

characteristics can be greatly improved: (1) yield of lint, (2) uniformity and length of lint, (3) size of boll, (4) resistance to disease, (5) earliness, (6) resistance to storms.

Climatic Conditions. — Since the native home of cotton is in the tropics, its production in the United States is limited to the warmer sections. Practically no cotton is grown north of the 37th parallel of latitude. It is not cultivated to any considerable extent north of the northern boundary of North Carolina and Oklahoma. Warm days and nights are very necessary during the early growth of cotton. Four or five months of high temperature are required for the complete maturing of this plant. There should be no frost later than April 1 nor earlier than November 1 for the best production of cotton.

Rainfall is a very important factor in cotton production, except where grown under irrigation. During the growing period, the rainfall should be abundant enough to furnish a good supply of moisture. During the picking season dry weather is desired, in order that the highest quality of lint may be produced, as wet weather accompanied by high winds is injurious to the quality of the lint.

Soils. — Cotton is adapted to a wide variety of soils. Sandy loam and clay loam usually give the best results. As a rule, light sandy soils produce the smallest yields. As cotton is a more profitable crop on poorer land than is corn, the uplands are generally planted to cotton and the more fertile lowlands to corn. Heavy clay soils or soils having a hard, compact subsoil are not suitable for cotton production. Commercial fertilizer in some form is usually applied to cotton fields. The type of soil and its fertility usually determine the kind of fertilizers used.

Planting and Cultivation. — Cotton requires a well-prepared seed bed. Practically all of the cotton land east of the Mississippi is prepared in the spring. As a rule, land intended for cotton receives only one plowing before the seed is planted. This practice usually consists of forming ridges or beds which are about forty inches apart and three or four inches high. The greater part of this plowing is done in February and March, the time depending upon the climate and soil conditions. On heavy clay land it is a common practice to plow in the fall in order that the soil may be pulverized by winter freezing.

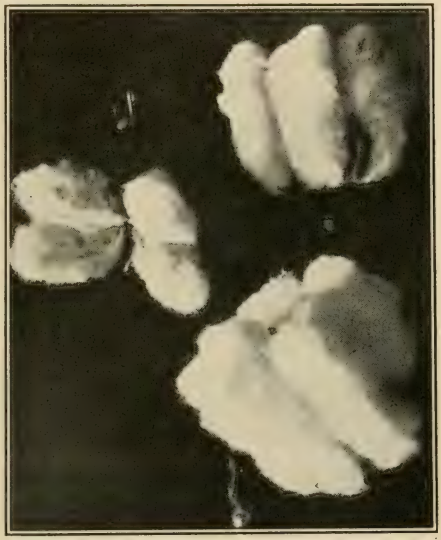

Fig. 109. — Specimens of cotton bolls.

Practically all cotton seed is planted with the single row drill, usually from one to two and a half inches deep. The amount of seed planted per acre depends largely upon the variety and varies from a half to one and a half bushels. Cultivation should begin just as soon as the plants can be seen in the row. The cheapest and best instrument with which to give the first cultivation is the ordinary spike-tooth harrow or weeder. The first two cultivations can be fairly deep. All subsequent cultivations

should be shallow. Thinning the cotton usually begins when it is about three or four inches high. The degree of thinning depends upon the variety, soil, and climatic conditions. On the poorer uplands, it is a common practice to leave ten to fourteen inches between the plants in the drill. On the low, fertile bottom soils, wider spacing is necessary and usually on such soils cotton is thinned to allow twenty-four to thirty inches between plants. Shallow cultivation is necessary, for the cotton plant puts out numerous feeding roots near the surface of the ground. Such cultivation should be continued until the plant is fairly well fruited. Usually the latter part of July or the first of August is the time for cultivation to cease. This, however, depends upon seasonal conditions.

There is nothing else that will increase the yield of cotton so easily and so cheaply as the growing of leguminous crops in a rotation. The following rotation is considered the best for the cotton belt, where rainfall will permit of the growing of these crops:

First Year. — Corn, with cowpeas sown broadcast between rows.

Second Year. — Oats, sown on the corn land, which was plowed in the fall. Cowpeas after the oat crop is harvested.

Third Year. — Cotton.

(This rotation cannot be practiced in the dry-farming section of the Southwest.)

Harvesting. — Picking is the most expensive operation connected with cotton production. The picking season usually opens the latter part of August or the first of September and is practically over by the middle of December.

A day's work for an average picker is about 175 pounds of seed cotton. However, skillful pickers are able to obtain

much larger quantities. An average yield is about 200 pounds of lint per acre. After picking, the most common practice is to haul the seed cotton to a public gin where the lint is separated from the seed. This separation is made by means of circular saws revolving at a very high speed. A large brush removes the lint from the saws and passes it

Fig. 110. — Loads of cotton ready for the cotton gin.

to a condenser from which it enters the press where it is compacted into bales. The size of bales varies somewhat but usually they are 27 by 54 inches and contain about 500 pounds of lint cotton. The bales are usually entirely covered with a coarse cloth, or "bagging," which is bound by six steel bands extending around the bale. For shipping purposes, these bales are pressed to a still smaller size in order to reduce the cost of shipping.

Marketing. — The quality and grade of cotton largely determine the price. The grade depends principally upon the color of fiber, the amount of trash, and the amount of immature fiber. The grade is not usually influenced by the length of fiber, but the length has an important influence in determining the price.

Principal Uses. — Cotton is grown mostly for its fiber which is used extensively in the manufacture of many kinds of cotton goods. A number of products are made from the seed. Large quantities of oil are extracted from the seed and the residue is used for cattle feed and as a fertilizer. Nitrogen is the chief fertilizer constituent in cotton seed. Phosphoric acid and potash are also present in small amounts.

A ton of cotton seed usually produces 750 to 900 pounds of hulls, depending upon the kind of machinery employed in the process. The hulls are used extensively as cattle feed.

Insect Enemies. — Several hundred species of insects are known to feed upon the cotton plant. Some of the more destructive are the boll weevil, bollworm, cotton caterpillar, and cutworm.

The boll weevil has spread over practically two thirds of the cotton belt and has done more damage than all the other insects combined. The boll weevil in the adult stage passes the winter in grass or any kind of crop residue left on the field. In spring the insects emerge and lay their eggs upon the young buds and later in the season upon the bolls of the cotton plant, into which the larvæ bore after hatching. As a rule all buds that are attacked drop off. However, the larger bolls may be attacked and still produce one or more locks of cotton. There are a

number of generations in one season and the injury is generally greatest the latter part of the season. It is estimated that the progeny of a single pair in one season may amount to 134,000,000 individuals.

Various methods have been employed in combating this pest. Reducing the number of insects in the fall by early destruction of the plants has proved fairly effective. The growing of early maturing varieties, early planting, use of fertilizers, proper spacing of plants, and thorough cultivation are other means used in controlling this insect.

Winds and flooded streams are important means of transporting boll weevils from infected sections to uninfected

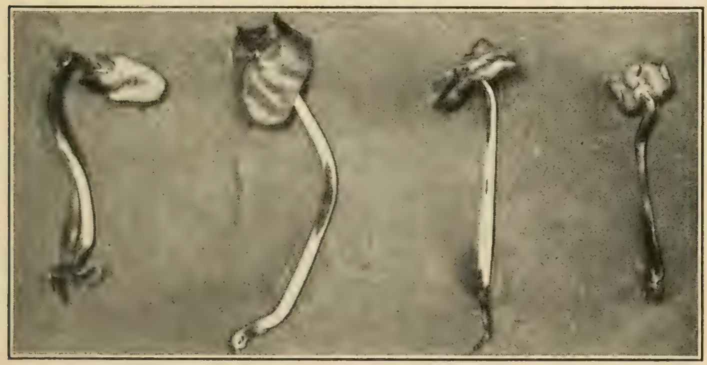

Fig. 111. — Early effect of anthracnose on young cotton plants.

areas. The pest is also disseminated by shipping seed into a territory from an infested section.

The cotton bollworm and caterpillar are difficult to keep under control in some sections. Poisoning seems to give fairly good results. Fall plowing is generally recommended.

Diseases. — In some sections, particularly in the humid regions, the cotton plant is subject to a number of diseases,

some of which do considerable damage. The following are the most important: cotton wilt, root knot, anthracnose or boll knot, root rot, and rust.

Diseases of cotton are controlled to a large extent by breeding of resistant varieties, rotation of crops, selection of clean, early varieties of seed, and proper cultivation.

EXERCISES

1. Outline a four-year rotation suitable for a cotton farm.

2. Which cotton fields are more likely to be seriously affected by the boll weevil, those on which cotton is grown in rotation once in three years, or those growing cotton every year? Why?

HOME PROJECTS

1. By actual trial determine the cost of producing and harvesting an acre of cotton.

2. Compare the yield of upland and Sea Island cotton by growing and harvesting equal areas of each, side by side, under the same conditions, keeping accurate records of all processes.

PART II. HORTICULTURE

CHAPTER I

PROPAGATION BY SEEDS AND SPORES

Propagation by seeds is the most general method of plant production. Most of the annuals, many of the flowering perennials and forest trees, and some of the shrubs are propagated by seeds. Even our fruit trees come from seeds planted in the nursery, which are later grafted or budded before transplanting to the orchard.

Seeds. — A seed is a small living plant in a dormant state, with a sufficient amount of plant food to maintain it until it can manufacture its own. Each kind of seed differs from that of every other kind, but it is often difficult to distinguish between some of these kinds. Cabbage and cauliflower seed, for example, are similar in most characteristics. As different plants may be identified by the variations in their foliage, flowers, stems, and fruit, so seeds may be identified by the variations in their form, size, color, taste, smell, and texture.

Testing Purity of Seeds. — The value of seeds depends first, upon their purity. Large seeds like corn and beans are generally pure, that is, they are not mixed or adulterated. Small seeds, such as those of our grasses and clovers, are likely to be mixed with weed seeds, dirt, chaff, and other useless and often harmful foreign matter. White clover, winter vetch, alsike clover, orchard grass, Canadian blue grass, and red clover are especially liable to

contain foreign seeds. It is essential, therefore, that only pure seed be purchased. Many states have passed laws compelling their seedsmen to offer for sale only those seeds that contain not more than a certain small percentage of impurities unless the percentage of impurity is indicated on the label.

Germination Tests. — After purity, the next most important quality is vitality. It is advisable, therefore, for the cultivator to know before planting whether his seeds will grow or not. We cannot tell by the exterior appearance of seed whether it is of high or low vitality.

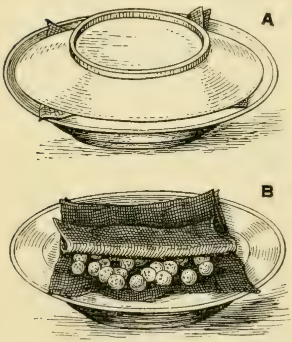

Fig. 112. — Seed testers.

The vitality of seeds depends largely upon their age. Some seeds, such as peas, will not germinate well after they are two years old, while other seeds maintain their vitality for several years. Chickweed seeds have been kept for twenty-five years and germinated at the end of that time. The length of time that seeds maintain their germinative power is called the longevity of seeds.

Seeds also fail to germinate when they have become too dry or when they have been subjected to freezing, especially before becoming sufficiently mature or dry. Seeds may fail to germinate also when they have been stored while damp or when they have failed to mature properly. One of the most frequent reasons, however, why seeds fail to germinate properly is that of unfavorable external conditions at planting time.

LONGEVITY OF SEEDS

(From Vilmorin's Tables)

Seeds	Average Longevity in Years	Extreme Longevity in Years	Seeds	Average Longevity in Years	Extreme Longevity in Years
Barley . . .	3	—	Orchard grass .	2	—
Bean	3	8	Parsnip . . .	2	4
Beet	6	10	Pea	3	8
Cabbage . .	5	10	Pumpkin . .	4 or 5	9
Carrot . . .	4 or 5	10	Purslane . .	7	10
Catnip . . .	5	6	Radish . . .	5	10
Cauliflower .	5	10	Rye	2	—
Clover . . .	3	—	Soy bean . .	2	6
Cucumber . .	10	10	Strawberry .	3	6
Dandelion . .	2	5	Tomato . . .	4	9
Kohl-rabi . .	5	10	Turnip . . .	5	10
Maize . . .	2	4	Watermelon .	6	10
Oats	3	—	Wheat . . .	2	7
Onion . . .	2	7			

External Requirements for Germination. — A seed, being a live plant in a dormant state, requires certain external conditions to resume its active growth. So long as any one of these conditions is wanting, the seed remains dormant and finally dies. The conditions necessary for germination are abundant moisture, warmth, and the presence of oxygen.

Moisture. — So long as seeds are kept dry, no matter how warm the surroundings may be, they will not germinate. The degree of moisture generally needed to start germination is complete saturation. To seeds in the soil, the moisture is furnished by the capillary action of soil water, and the more quickly this saturation takes place, other conditions being favorable, the sooner the seeds germinate.

This has led to the practice of soaking seeds before sowing, especially hard-coated ones like asparagus or canna seed, to hasten germination. Beans and corn are sometimes soaked overnight before planting.

Temperature. — Few seeds will germinate in a temperature below freezing. It is because of low temperature that weed seeds fail to grow during the winter, and remain dormant until the soil becomes warmed by the sun in the spring. Corn fails to germinate if planted too early in the spring while the soil is still cold. The required temperature, however, varies with different seeds. The seeds of peas, radishes, and lettuce germinate at a lower temperature than corn and many other garden seeds. For most seeds, a temperature of 75° to 90° F. is best. Great extremes between the temperature of the day and that of the night retard germination. With small delicate seeds extremes of temperature are exceedingly injurious.

Fig. 113. — Sowing seeds. An even depth of seeds in fine, moist soil promotes good germination.

Oxygen. — Free oxygen is essential for germination. This element is required in the process by which the stored-up food in the seed is made available for the young plant. Seeds, if soaked in a jar of water, will enlarge and apparently start to germinate, but if kept submerged and the surface of the water oiled to prevent oxygen from reaching

the seeds, they will die from lack of oxygen. Seeds planted in wet and poorly drained soil often fail to germinate because the excessive quantity of water excludes the necessary oxygen.

Time Required for Germination. — The time required for germination varies greatly with the different kinds of seeds as well as with the conditions of temperature, moisture, and oxygen. Lettuce and radish seeds will germinate under ideal conditions in a few days, while celery seed requires a much longer period. Some kinds of tree seeds do not germinate for two or more years after they are placed in the ground. Therefore, in seed sowing, it is well to know the time required for germination that provision may be made for such a period.

AVERAGE TIME REQUIRED FOR COMMON SEEDS TO GERMINATE

Seed	Days	Seed	Days
Bean	5–10	Lettuce	6–8
Beet	7–10	Onion	7–10
Cabbage	5–10	Parsnip	10–20
Carrot	12–18	Pea	6–10
Cauliflower	5–10	Pepper	9–14
Celery	10–20	Radish	3–6
Corn	5–8	Salsify	7–12
Cucumber	6–10	Tomato	6–12
Endive	5–10	Turnip	4–8

Seed Sowing. — Knowing the essentials for germination, one must endeavor to provide ideal conditions. Much of the vitality and vigor of seedlings is often lost by sowing seeds whose strength is spent in the effort to

develop under unfavorable conditions. The more quickly the seeds germinate after being sown, the more vigorous the plants will be and the less trouble the cultivator will encounter from weeds. Ideal moisture conditions are supplied by planting in a well-drained soil of good texture and containing enough humus to maintain the moisture. In addition the soil should be well prepared and well compacted about the seeds.

In sowing seeds out of doors, the temperature is determined largely by the season and by the depth of planting. As a rule, seed should be sown only as deep as moisture conditions require, because usually the soil at the surface is warmer than that lower down. Depth of sowing is also governed by the size of the seed as well as by its vitality. Large, vigorous seeds can be sown deeper than small weak seeds. In indoor sowing, very small seeds like begonia or cineraria are simply scattered over the surface of the soil.

A sufficient supply of oxygen is assured if the seed is not planted too deep and if the soil does not become too wet or puddled. To insure an even depth of planting, the soil should be finely pulverized. Small weed seeds when plowed under in the spring probably remain dormant because of the lack of oxygen.

Seed Storage. — As seeds are living plants in a dormant state, it is very essential to provide favorable external conditions for their storage. All thin-coated seeds should be stored in a dry place in which the temperature is above freezing; while hard-shelled seeds require moisture and often freezing for ideal storage conditions. If the atmosphere in a storage room for thin-coated vegetable and flower seeds is damp, it should be dried by artificial means. Nearly all nuts and many of our common fruits

having hard seed coats are stored by stratifying them in moist sand and burying out of doors. This is called seed stratification.

Seed Stratification. — To stratify seeds, a well-drained spot is first selected. Then the seeds are buried in layers alternating with sand at such a depth that they will freeze, but not be subject to alternating freezing and thawing. Small seeds may be placed in a shallow box with very fine sand and the box buried out of doors. Many seeds do not germinate the first year and by stratifying them, the space that they would otherwise occupy in the field is saved. It is only a waste of ground to sow such seeds in the soil the first year. Fall sowing of apples and peaches amounts to the same thing as stratification. It is always advisable to mulch with straw seeds sown at this time. Seeds should be stratified as soon as possible after they have matured.

Propagation by Spores. — Many of the non-flowering plants, as ferns and mushrooms, do not produce seeds. Instead, small spores are formed on the under surfaces of the leaves. These spores differ from seeds in that they do not contain an embryo or young plant, but are simply one or few-celled structures. In the propagation of plants from spores, the same general conditions are necessary as for seeds, but moisture and drainage are of even more importance. Spores are extremely small and delicate, hence the depth of sowing is very important. They are usually sown in pots. The pot is filled about half full with broken pots or bricks and the top soil prepared extremely fine. Over this the spores are sprinkled. The pot should be set in a saucer of water and covered with a pane of glass to maintain moisture. It should then be

placed in a warm room where an even temperature can be maintained. The spores will germinate in three to six weeks.

EXERCISES

1. What is plant propagation?

2. What are the advantages of testing seeds before planting?

3. Has your state any law regarding the amount of weed seeds that a given sample of seed may contain? If so, how much does the law allow?

4. What is the relation of the depth of planting to the oxygen supply?

5. Explain in detail the method of stratifying seeds.

6. How does a spore differ from a seed?

7. If red clover seed containing 305,000 seeds per pound is composed of 3 per cent weed seeds by count, how many weed seeds are sown in a square foot when the clover is sown at the rate of 10 pounds per acre?

8. If a seed sample contains 95 per cent of pure seed, of which 90 per cent germinates, what per cent of the entire sample is viable?

9. Examine samples of radish, spinach, lettuce, celery, parsnip, carrot, cucumber, melon, and other important vegetable seeds at hand. Describe the form, color, size, texture, taste, and smell of each.

(*To the teacher:* Make mixtures of these seeds and have students separate and identify each kind.)

10. Make a germination test of 100 seeds each of peas, beans, cucumbers, cabbages, radishes, and corn. To make the germination test, take two pieces of blotting paper and place them in a plate. The blotting papers should be kept soaked and the seeds placed between the blotting papers. The plate should be kept in a warm place and at an even temperature, 70° F. or over.

Note the number of each kind germinating each day, and

finally estimate the percentage of germination. Tabulate your results in your notebook. It should be remembered that the so-called seed of the beet is really a seed ball, which usually contains more than one seed. Therefore, it is impossible to get an accurate test of the so-called beet seeds.

11. Bring to school a sample of each kind of soil on your farm. Can you tell by the appearance of a soil whether it is a cold soil or a warm soil? Is it advisable to plant early seeds such as radishes and lettuce, on a cold soil? Are some of your soils better suited to late than early crops? Test the relative moisture content of these samples. Can you judge from your sample whether or not it would provide a sufficient supply of oxygen to germinating seeds? How could you improve this character?

HOME PROJECTS

1. Make purity tests of any three of the following kinds of seeds at your farm: Kentucky blue grass, alsike clover, winter vetch, white clover, alfalfa, and orchard grass. Tabulate the results. (When results are to be tabulated, the teacher should suggest the appropriate form to be used.)

2. Take a sample of 100 seeds of any three of the following kinds of seeds: onion, corn, celery, tobacco, tomato, clover, parsnip, orchard grass, and wheat. Make a germination test of each and tabulate results.

CHAPTER II

PROPAGATION BY SEPARATION, DIVISION, AND LAYERAGE

Propagation by Separation. — Many plants accustomed to long periods of inactivity form specialized buds that are provided with an abundant food supply, which enables them to withstand adverse conditions and later to develop into plants. These buds break away from the parent plant and after being detached are able to live a separate existence. These specialized buds are classified as bulbs, bulbels, bulblets, corms, and cormels. Propagation by means of these buds is called separation.

Fig. 114. — Easter lily bulb, showing bulb scales.

A Bulb is a short stem containing a terminal bud surrounded by thickened leaves called bulb scales. These thickened leaves are stored with plant food which maintains the plant until it is able to manufacture and digest its own food. There are two special classes of bulbs: (1) the scaly bulbs, as those of the Easter lily (Fig. 114), made up of bulb scales that are narrow, thick, and loose, and (2) the laminate bulbs composed of close-fitting thin layers, as in the onion.

Bulbs are generally formed just beneath the surface of the ground. Sometimes but one large bulb is produced

by each plant, but frequently bulbs divide themselves into two or more equal portions, each of which may separate and become a complete bulb. This method, however, is too slow if one desires to multiply them very rapidly.

Bulbels. — Small bulbs generally develop around the large "mother" bulb. These are called bulbels and may be separated and planted by themselves. Some plants do not produce bulbels freely, but they can be induced to do so by wounding or mutilating the "mother" bulb. This method of propagation is resorted to in propagating a large stock of a new variety. Bulbels may be treated as matured bulbs although they will seldom flower the first year. In fact, most bulbels require two or three seasons to reach sufficient size to form large flowers. This is the method by which hyacinths are propagated in Holland.

Fig. 115. — Corm of gladiolus with cormels attached.

A Bulblet is a small bulb borne entirely above ground in the axils of the leaves as in the tiger lily, or at the top of a stem as in the "top" onion.

Corms and Cormels. — Corms are produced quite similarly to bulbs but differ from them in being solid throughout. The food here is deposited in the thickened stem. Small corms or cormels are developed similarly to bulbels and the corm may also be mutilated in the same manner as bulbs to induce the formation of cormels. The crocus, gladiolus, and caladium are corm-producing plants.

Propagation by Division. — Many plants are propagated by cutting or breaking the parent plant into several pieces. This method of propagation is known as division. Propagation by division is practiced principally with tubers, rootstocks, crowns, stolons, and suckers.

A Tuber is a thickened portion of a stem that grows beneath the surface of the soil. The Irish potato and the dahlia are familiar examples. These plants are multiplied by either planting the entire tuber or dividing it into portions each of which must contain a bud or "eye."

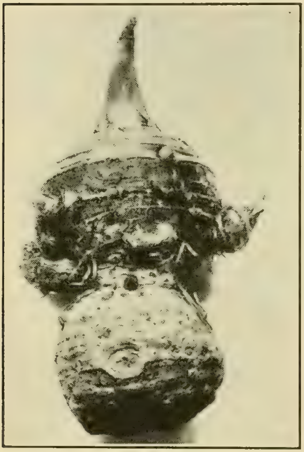

Fig. 116. — A new corm of caladium, with cormels, and the old corm at the base.

A Rootstock is a prostrate, much thickened stem which pushes out lateral roots in all directions and upon which buds are formed. These buds when detached develop into new plants. The rootstock may be separated into as many parts as there are buds and each part treated as a separate plant.

Crowns. — With some plants the rootstock during the summer develops on each rooted branch a strong terminal bud. Each branch thus formed containing roots and a terminal bud is called a crown. This may be dug in the fall when the plant is dormant and divided into as many parts as there are crowns and each treated as an independent plant.

Stolons are trailing branches often known as runners. Roots start at the nodes of the runner and thus new plants are produced. After the young plants are well rooted

they may be separated from the parent by cutting the stolons. Strawberries and cranberries reproduce by means of stolons.

Suckers are young plants that are produced from underground stems or roots. This method of propagation is

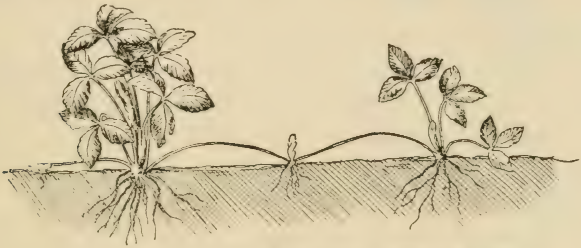

Fig. 117. — Reproduction of strawberry plants by stolons.

used in producing new plants of the red raspberry and blackberry. The growth of suckers may be induced by heavy fertilization and severe pruning.

Although this method of propagation is not generally practiced on a commercial scale with many plants, it is a very convenient one for private use in multiplying many of the flowering perennials and herbs, as well as spireas, deutzias, roses, and similar-growing shrubs.

Propagation by Layerage. — Plants that do not readily take root from cuttings may often be conveniently propagated by layerage. By this method a branch is brought in contact with the earth in such a manner as to induce it to throw out roots and stems, thus forming a separate plant. Layering is especially convenient for reproducing plants with more or less decumbent branches, and as the parent plant supplies the food and water until the layer is established, it is a simple and easy method of propagation. Plants that do not readily send out roots can often be induced to

do so by bending, twisting, notching, or otherwise mutilating that portion of the stem from which the roots are to be formed. In commercial practice, the grape, quince, currant, gooseberry, and some of our ornamental plants are multiplied in this manner. There are several modes of layering plants, which differ only in the way the operation is performed.

(1) **Simple Layering** consists in bending down a stem, covering with soil the portion at which the roots are desired

Fig. 118. — Serpentine layering.

and leaving the terminal portion uncovered. The buried portion should contain a node as this is the point where roots most readily form.

(2) **Tip Layering** consists of bending the branch or cane down to the ground and covering the tip with soil. The cane or branch will throw out roots and develop a new plant at the covered tip. The black raspberry propagates naturally in this manner.

(3) **Serpentine or Multiple Layering.** — When many plants are desired from a single stem, it is pinned to the ground and covered at frequent intervals, thus inducing the plant to form roots at more than one point. After the roots have formed, the vine may be cut between these points, leaving a number of independent plants. The grape and many ornamental vines are readily propagated by this method.

(4) **Mound Layering** is another method of obtaining many plants from a single individual. This is performed by cutting back the old plant to the ground early in the spring to stimulate the formation of many new shoots. The succeeding fall or spring the soil is ridged up about the plants high enough to cover the lower nodes of the new branches. From these nodes roots are formed which are sufficiently strong to be separated from the parent plant the following fall. The gooseberry, quince, and many of the ornamental shrubs may be propagated in this manner.

(5) **Air Layering.** — Sometimes it is impossible to bring a branch in contact with the ground. In such a case, soil or moss is placed around the branch and held in position by some artificial means. If this covering is kept moist, roots will develop and a new plant will form. The rubber plant so common in our homes may be multiplied in this manner.

EXERCISES

1. What is propagation by separation?

2. What is the difference between a corm and a bulb? Are they propagated in the same manner?

3. What is a rootstock? How can you tell an underground

stem from a root? Dig up the underground parts of a specimen of quack grass. Note the rootstock.

4. Draw both cross and longitudinal sections of an onion (bulb) and a crocus (corm) and label properly.

5. Study a young strawberry plant. How are these plants propagated? Notice the runner which joined the young plant to the old plant and also the runner which the young plant is sending out. Is there a bud at the end of the young runner? Is it a leaf or fruit bud?

6. What two causes are the most potent ones in causing plants and trees to sucker?

HOME PROJECT

Select two kinds of hardy shrubs, two kinds of ornamental vines, and three kinds of fruits that may be readily propagated by layerage. Grow five new plants of each, using the following methods of propagation: simple layering, tip layering, serpentine layering, and mound layering. Separate and plant in suitable places.

CHAPTER III

PROPAGATION BY CUTTINGS

A CUTTING is a detached portion of a stem which, when inserted in sand, soil, water, or some other favorable medium, will produce roots. It is not a natural means of multiplication, but is used to propagate plants that do not come true to seed, or those that do not propagate more readily in some other manner. Nearly all plants may be propagated by cuttings, but some species and even some varieties of the same species may be multiplied more readily than others by this means.

That a cutting may develop a new plant, it must possess the following essentials: (1) a certain amount of healthy tissue, (2) stored food, and (3) a growing point. The portions of the plant selected for cuttings are, therefore, the younger matured growths of the roots or stems containing one or more buds.

External Requirements. — In order that cuttings may callus and send out roots readily, certain external conditions must be supplied and maintained. The principal conditions are temperature, moisture, and soil.

Temperature. — It is important that the temperature be carefully controlled. Heat stimulates plant growth, hence in the propagation of plants by cuttings, it is especially desirable to supply bottom heat that the soil may be warmer than the air. This tends to stimulate the formation of roots, and checks the growth of the foliage until

roots are formed to supply food and moisture. Many plants will not root at all without bottom heat. This is supplied out of doors by the natural heat of the soil in the spring and summer, and for some plants, this is often sufficient. With others, however, it is necessary to raise the temperature of the soil by artificial means. In greenhouse work the soil of the cutting bench is heated by steam or hot-water pipes placed beneath it. Hotbeds are often used, the heat of the soil being raised by the fermenting manure placed below the soil. Frequently cuttings are buried inverted with their bases nearest the surface of the soil. This tends to hold the buds in check and accelerates the rooting. If placed out of doors in the fall or early spring, the ends should be callused and ready for planting by May or early June.

The air temperature is also important. It is desirable and often necessary to check the growth of tops until the roots have formed. A cutting supplied with warm air soon exhausts the meager amount of food stored in its leaves, and as it cannot well take in moisture until the root hairs have developed, it may wilt and die. It is, therefore, necessary to maintain a low air temperature. In practice this is accomplished by means of shading and ventilation, or by burying cuttings in an inverted position as has been described.

Uniformity in temperature is very important. The variations between day and night temperatures are not conducive to the most favorable development of cuttings. Under most conditions a soil temperature of 65° F. and an air temperature of 50° to 55° F. is ideal. Frequently, however, the temperature of the soil may be raised somewhat higher to hasten the development of roots.

Moisture. — Moisture is essential to prevent wilting and to promote root development. It is furnished to the plant by means of frequent waterings and maintained by shading to reduce transpiration. With plants having a large leaf surface, it is especially important that the air be kept in a moist condition.

Various devices are used for confining the air about cuttings to prevent excessive evaporation. A bell jar is probably the simplest method. A very practical device for the home consists of a box covered with a pane of glass. In greenhouse work, the cutting bench is covered with sash when the required moisture cannot be easily maintained by other means. Generally, however, frequent watering and shading by means of whitewashing the glass of the greenhouse or by placing lath screens above is sufficient to prevent excessive transpiration.

Fig. 119. — Plant growing under a bell jar to prevent excessive evaporation.

Soil. — The medium in which the cutting is placed for rooting is as important as the temperature and moisture conditions. Some plants may be rooted by placing the cuttings in water. Others may be rooted by placing them in moist sphagnum moss; but as a rule, soil is most satisfactory.

An ideal soil for cuttings should be of such a texture as to become neither puddled nor baked. Since drainage is of so much importance, coarse, clean sand that is free from clay and organic matter is to be preferred for greenwood cuttings. Fine sand packs too firmly about the cutting, while organic matter in the soil holds too much moisture and promotes the growth of injurious plant diseases. Coarse sand also induces the formation of longer and better roots. For some of the hardwood cuttings planted out of doors, a good garden soil of a light mellow character is preferred. All cuttings except the willow, dogwood, poplar, and other plants thriving naturally in wet soils prefer good drainage.

Classes of Cuttings. — Cuttings are divided into four classes with reference to the parts of the plant from which they are taken. These are tuber cuttings, root cuttings, leaf cuttings, and stem cuttings.

Tuber Cuttings. — Plants forming tubers are generally multiplied by tuber cuttings. The essentials of a tuber

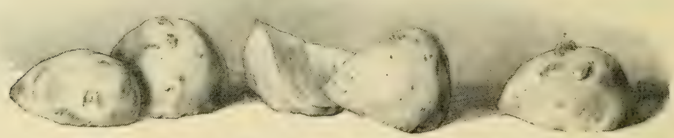

Fig. 120. — Tuber cuttings of Irish potatoes ready for planting.

cutting are a bud or eye and a sufficient piece of the tuber attached to produce growth. The roots of a tuber cutting come from the base of the sprout produced, and by removing these sprouts as soon as they form roots and leaves new plants are obtained. In this manner, a large number

may be produced from a single tuber. Sweet potatoes are propagated in this manner. Irish potatoes are propagated usually by using the whole tuber or a portion of it containing one or more eyes. Many experiments have been performed to ascertain the ideal size to plant for seed to obtain the maximum yield. In most cases, the larger pieces have given the greater yields, and good-sized potatoes cut in halves have yielded more than small potatoes similarly cut, and more than larger ones cut into many pieces.

Root Cuttings. — Of the plants commercially propagated by root cuttings, the horse-radish and blackberry are familiar examples. The smaller roots are cut into pieces one to four inches long as soon as the growth ceases in the fall, and are packed in boxes with moist sand or moss. They are then placed in a cool cellar for the winter and planted out of doors in the spring. It is difficult to tell the base from the top of horse-radish cuttings, and as it is necessary to plant them in an upright position in the soil to obtain good straight roots, the cuttings are made with a diagonal cut at the bottom and a horizontal cut across the top. Blackberry cuttings may be planted horizontally in the soil.

Fig. 121. — A rooted leaf cutting of *Rex Begonia*, showing formation of new plant.

Leaf Cuttings. — Plants, like the begonias, having thick fleshy leaves, store large quantities of plant food either in the body of the leaf or in its larger ribs. When these ribs are

ruptured and placed in contact with moist sand, they readily develop stems and roots. With such plants, the following method of propagation is practiced. The leaf may be spread upon a cutting bench and pinned down with toothpicks thrust through the ribs, or the ribs may be cut slightly, and the leaf held in close contact with the surface of the sand by means of light weights placed on top of the leaf. From the wounds, roots develop, and the plant afterwards produces leaves.

Leaves may also be cut into small wedge-shaped pieces, each piece containing a portion of a midrib. These pieces may be set vertically in the sand like ordinary cuttings, and roots will develop from the point of the midrib. In selecting leaves for cuttings, vigorous, healthy, well-matured ones should be used. Leaf cuttings are handled in the same manner as softwood cuttings, in so far as temperature and moisture are concerned.

Stem Cuttings. — One of the most common methods of propagation is by stem cuttings. From some plants, the cuttings are taken when the wood is matured; cuttings thus taken are called hardwood cuttings. From other plants they are taken from the growing immature stems, and are called softwood cuttings. As the treatment for each is quite different, it is necessary to consider them separately.

Hardwood Cuttings are made any time after the stems have dropped their leaves in the fall, and before the buds start in the spring. The wood at this time is matured and quite dormant. Hardwood cuttings generally require a long time to root, therefore it is advisable to make them in the fall or early winter in order to allow them time to callus before spring.

If bottom heat is to be supplied to the soil in which the cuttings are placed, they will be found to do better if given a rest before starting their growth.

Often hardwood cuttings are taken in the early fall and planted directly in the field. Currants, gooseberries, and

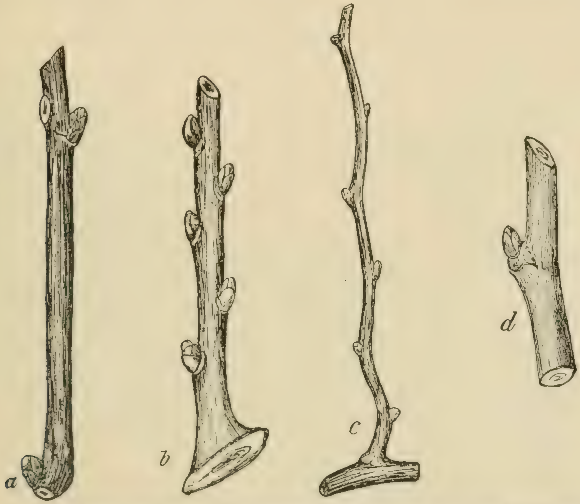

Fig. 122. Hardwood cuttings: (*a*) simple cutting; (*b*) heel cutting; (*c*) mallet cutting; (*d*) one-eye cutting.

sometimes grapes are propagated in this way. There is no rule governing the length of a hardwood cutting although they are generally made from eight to ten inches long. The cutting should contain one or more buds below the ground and one above.

The various kinds of hardwood cuttings may be classified as follows: (1) simple, (2) heel, (3) mallet, and (4) one-eye cuttings.

(1) **A Simple Cutting** consists of a portion of a stem having two or more buds. The base of the cutting is generally

made just below a node, as roots seem to form more readily at this point. The top is cut some distance above the highest bud. Usually the stem is of the present or past season's growth rather than of older wood, although with some plants the base is often cut at the annual ring just below the past season's growth. This method of making cuttings is used with currants, gooseberries, grapes, dogwoods, willows, poplars, and many of the ornamental shrubs and trees.

(2) **A Heel Cutting** is made like a simple cutting, but with a small portion of the parent branch forming a heel at its base. Some stems root most readily when cut in this manner.

(3) **A Mallet Cutting** is formed when an entire section of the parent branch is removed instead of a heel. Often plants that will not take root by simple cuttings are easily propagated by this form. Many evergreens and some deciduous trees root more readily from mallet and heel cuttings than from the other cuttings.

(4) **One-eye Cuttings** may be used when a large stock of cuttings is desired from few plants. These consist of stem cuttings having but one bud, the stem being cut a short distance below and above a bud. These cuttings often require artificial heat to stimulate their callusing. If made in the fall, the cuttings may be layered in a box of sand and placed in a cool greenhouse over winter. In planting out in the spring, they should be placed horizontally about an inch below the surface of a moist and finely prepared soil. As such plants are not so strong as those from two-eye or three-eye cuttings, greater care is necessary in planting. It is not advisable to use them except when more vigorous cuttings are unavailable.

Softwood Cuttings may be used in the propagation of nearly all greenhouse plants. For this purpose, wood that is neither too soft nor too hard should be selected. Firm and brittle stems root most readily. In propagating herbaceous plants by softwood cuttings, the tips of the rapid growing shoots are selected. Such cuttings may vary in length from an inch to three or four inches with

Fig. 123. — Softwood cuttings. A geranium plant and shoot taken from it for a cutting. The one held in the hand is ready for planting. Carnation cuttings in the background.

different plants. Although the base of a cutting is generally cut below the node, it is not always necessary to do so, especially with herbaceous cuttings that root very readily. The leaves are generally removed from the lower portion of the stem and the cutting planted deep enough to hold it in place and insure uniform temperature and moisture. Sometimes a portion of the remaining

leaf surface is cut off to reduce transpiration and prevent wilting.

The cuttings are then placed in sharp sand in a cutting bench or propagating box. As the cuttings should never be permitted to wilt, it is well to water them immediately after planting and to shade them with newspapers.

Cuttings of many of our ornamental shrubs and vines are made during the summer months from the partially matured growths and placed in outdoor frames. These should be given protection during the first winter but afterwards may be treated the same as plants from hardwood cuttings.

EXERCISES

1. Give in detail the three essentials of a good cutting. How would you proceed to determine whether a cutting is of strong or weak vitality?

2. What are the external requirements of cuttings? Why apply bottom heat? Suggest three methods of applying bottom heat to herbaceous plants.

3. Make samples of simple, heel, mallet, and one-eye cuttings of the grape or some other woody vine.

4. Obtain specimens of cactus, begonia, peperomia, or other thick-leaved plants and examine, noting spines, mode of protection from outside, and thickness of leaf. Make three outline drawings of the leaf and show by dotted lines where the leaf should be cut to propagate it by the many different methods of making leaf cuttings.

HOME PROJECTS

1. Plant two rows each of large whole potatoes, medium-sized whole potatoes, small whole potatoes, medium-sized seed halved, medium-sized seed quartered, medium-sized seed cut to

three eyes, medium-sized seed cut to two eyes, and medium-sized seed cut to one eye. Label each row. Tabulate results.

(*To the teacher:* This work should extend through one season and the student should be given credit for thoroughness and completeness of work done.)

2. Make several hardwood cuttings of each of the following plants: currant, gooseberry, grape, rose, barberry, spiræa, deutzia, lilac, philadelphus, willow, dogwood, poplar. Tie in separate bundles, label, and pack in a moist cool place. Handle and plant in the spring as outlined in the text.

CHAPTER IV

GRAFTING

GRAFTING is the process of inserting a stem or bud of one plant into another plant in such a manner that the two unite and grow. The portion of the plant to which the graft is applied is called the stock and the piece inserted in the stock is called the scion. The stock furnishes the nourishment and the future growth develops from the scion.

The cambium layer is the living tissue between the wood and the bark. In all kinds of grafting, it is essential that the cambium of the stock and scion touch each other. When the graft is made, the wounded cambium of both scion and stock begins to produce a new tissue known as the callus. The two parts, being maintained in rigid contact, grow together making a permanent union.

Functions of Grafting. — (1) Grafting is used to multiply varieties that will not come true from seed. The seeds of most of our tree fruits produce plants that bear fruits unlike the parents and generally of inferior quality. Seeds of the Baldwin apple or of the Bartlett pear do not produce trees of these varieties. Hence, to produce a tree of similar characteristics, it is essential to propagate by grafting. All the common tree fruits of America and many of the ornamental shrubs and trees are propagated by this means. The principal function of grafting, therefore, is to perpetuate varieties.

(2) Grafting is also used to change the natural habit of growth or stature of a tree. Apples are grafted upon slow-growing sorts that tend to produce a slower growth of the scion. For the same reason, pears are grafted upon quince. Weeping willows and mulberries are often grafted upon stocks producing straight upright trunks, thus forming umbrella-shaped trees. In these as well as in other ways, grafting is used to change the stature of a plant.

(3) Grafting is used to adapt varieties to soil conditions. Plants are frequently grafted upon stocks that thrive better upon the soil that is to be used to grow them. Plums thrive best upon a moderately heavy soil while peaches prefer a sandy soil. In growing peaches, therefore, upon a heavy soil they are often grafted upon plum stocks, and plums to be grown upon sandy soil may be grafted upon peach stocks.

(4) Grafting is also used to change an undesirable variety to a desirable one. When a tree comes into bearing it may be found to be of an undesirable sort. As it takes ten years for most of our apples to come into bearing, one can hardly afford to destroy a tree and wait for a new one to come into fruit. Upon the branches of the undesirable tree may be grafted the scions of a desirable variety, and in a few years the tree will produce abundant crops of the desired variety.

Limitations of Grafting. — Probably all plants which contain a distinct bark and wood can be grafted. There is no definite rule, however, and the only method of determining the affinity between two kinds of plants is by trial. Under ordinary conditions, however, the following results are obtained.

(1) Different varieties of the same species almost *always* unite. The Northern Spy apple may be grafted upon the Baldwin apple although the Bartlett pear does not take so well upon the Kieffer pear. In the former case the fruits are of the same species while in the latter they are of different species.

(2) Plants of different species but of the same genus *often* unite. Peaches, for example, may be grafted upon plums, or plums upon peaches. Sometimes a graft may be worked one way successfully, but it may fail to unite in the opposite way. The sweet cherry will grow upon a Mahaleb stock, but the Mahaleb will not grow upon the sweet cherry stock.

(3) Plants of different genera but of the same family *sometimes* unite. The pear, for example, unites successfully upon the thorn, and the oak upon the chestnut; in fact, the pear grafts more successfully on the thorn than upon other pears. Generally, however, plants do not unite as successfully when of different genera as when the botanical relationship is closer.

Kinds of Grafting. — The three principal kinds of grafting are budding, scion grafting, and inarching or approach grafting.

Budding. — Budding is really the grafting of a small portion of bark containing a living bud. It is used with stock of small diameter and preferably not more than one year old. There is no definite rule, however, as to which plants should be budded in preference to scion grafting. Many plants, as the apple and pear, are propagated both ways, depending much upon local conditions. Budding is the only method extensively used, however, in propagating all stone fruits such as the peaches, plums, and cherries.

Budding is usually performed in the North during late summer and early fall, while in the South it is frequently performed in June. It may be done at any time of the year when mature buds can be obtained and the bark slips readily. When spring budding is practiced in the North, the buds are secured from twigs of the previous season's growth; but with late summer work, the buds are secured from growing twigs of the present season.

Selecting Buds. — Twigs from which the buds are selected are known as bud sticks. Strong twigs of the present season's growth are selected for bud sticks. As these twigs are usually cut while still in foliage, it is necessary to keep them from wilting. Usually the leaves are clipped at once to lessen the transpiration of moisture. About half an inch of the petiole of the leaf beneath each bud is left on to serve as a handle while inserting the bud. The weak buds at the tips of the branches are generally discarded unless the number is limited, as sometimes happens in propagating new varieties. The bud sticks should be wrapped in moist cloth as soon as cut and kept in a cool place until ready for use.

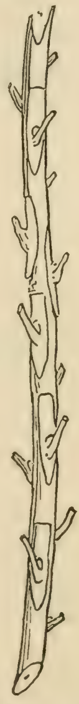

Fig. 124. — A bud stick showing method of cutting the buds.

Cutting Buds. — From a bud stick, a bud with a piece of bark is cut out in the form of a shield about an inch long. The cut should be deep enough to remove but a small portion of wood that is cut away with the bud. Some grafters prefer to remove this wood before inserting the bud in the stock while others do not. If the bud has been cut very deep,

however, or if the wood is hard and dry, it is better to remove it.

Inserting Buds in Stock. — The stock is prepared by removing all the leaves and branches from the area to be budded. Peaches, plums, and other nursery trees are generally budded as near to the ground as the operator can work, or not more than two or three inches above the surface of the soil. The bud is usually set on the north side of the stock that it may be shaded from the sun and kept cool and moist. A budding knife having a thin blade curved at the end (Fig. 125) is used to make the incision, which consists of a vertical slit about an inch long and just deep enough to cut through the inner bark, and also a horizontal cut made across the top of this vertical cut, forming the capital letter "T." (Fig. 126 *a*.) The bark is then loosened to receive the bud. (Fig. 126 *b*.) The bud is inserted and pushed in under the bark as far as possible with the finger; then the back of the knife blade is thrust against the petiole of the leaf, and the bud is pushed into its final position. (Fig. 126 *c*.) If a small portion of the bark is still above the incision, it may be cut away without harm. The bud is then tied with raffia, soft string, or tape, by winding it around once or twice both below and above the bud.

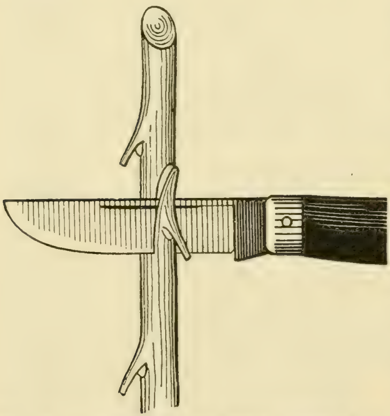

Fig. 125. — Cutting a bud with a budding knife.

(Fig. 126 *d.*) This is left for one or two weeks during which time the bud sets. The tape is then cut to prevent girdling.

A bud inserted in late summer remains dormant until the following spring. After it begins to grow in the spring, the stock should be cut just above the bud that the growth of the bud may be accelerated and the wound quickly healed over. (Fig. 126 *e.*) All suckers and water sprouts should be kept pruned off.

Splice Grafting. — Splice grafting is a form of scion grafting used to unite small scions and stocks of nearly the

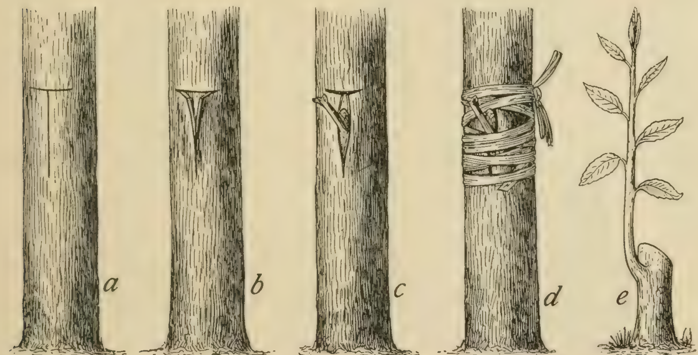

Fig. 126. — Steps in the process of budding.

same size. The base of the scion is trimmed with an even diagonal cut and the stock is cut in a similar manner. The two are then placed together so that the cambium layer of one is in contact with the cambium layer of the other, at least along one side of the union, and the graft is bound tightly with soft string, waxed cloth, or grafting cord to hold the two parts in place. This is the simplest graft to make but it does not hold so well as some other forms.

Tongue Grafting. — This method is the same as splice grafting except that a vertical cut is made along the diagonal cut in both stock and scion to form a tongue. When the tongues are inserted or pushed together they not only expose more of the cambium but also exert a binding force and a better union is insured. The graft should be wound with waxed cloth or cord as in the splice graft. This method is universally used in root grafting. Seedling stocks with long straight taproots are desirable for this purpose. In whole root grafting, the entire root is used with each scion. In piece root grafting each root is cut into two or more pieces.

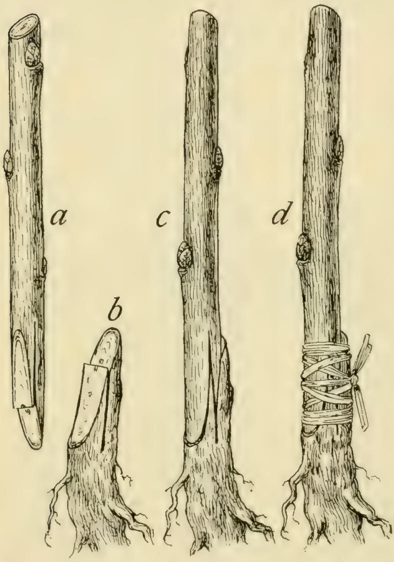

Fig. 127. — Tongue grafting: (*a*) the scion; (*b*) the stock; (*c*) stock and scion united; (*d*) graft wrapped.

Root grafting is used to propagate many of the apples, pears, and other pomaceous fruits. This form of grafting has an advantage over budding in that it is usually done indoors during the winter, while budding must be performed during the growing season. Both scions and roots are collected in the late fall and stored in sand, sawdust, or moss, in a cool place. About January or February the stock is grafted. The complete grafts are wrapped tightly with waxed string or cloth and stored in a cool, moist place until spring. Callusing will

have taken place by that time, and when planted in the nursery row the scions will start to grow.

Cleft Grafting. — When branches of from one to two inches in diameter are grafted, the cleft graft is the method commonly used. This consists simply in cutting off the branch at right angles and with a grafting chisel making a cleft deep enough to accommodate the scions. For this purpose the scions are collected during the late fall or early winter, although success is frequently obtained with scions cut at the time of grafting. The twigs selected should be about eight to ten inches long, of the past season's growth. They are then generally cut into pieces each containing two or three buds. The base of a scion is trimmed to form a wedge, about one and a half inches long. The outer edge of the wedge is made slightly thicker so that the pressure of the stock against it on this side may bring the cambium layers in close contact. It is also desirable to have a bud on the outside of the scion just above the wedge. The scions are then inserted into the cleft in such a manner that the

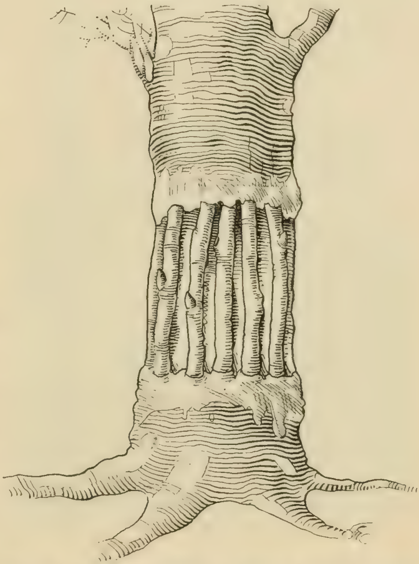

Fig. 128. — Bridge grafting. When the bark of fruit trees has been injured by mice or rabbits the trees may often be saved by this method of grafting.

cambium layer on the outer side of the scion may be in contact with the cambium layer of the stock. That the cambium surfaces may be brought into direct contact, at least at one point, the scions are generally slanted slightly outward. Two scions are placed in each cleft to insure success, and if each grows, the weaker one is afterwards removed.

Cleft grafting is extensively used in top-working trees. A most important factor in this process consists in the

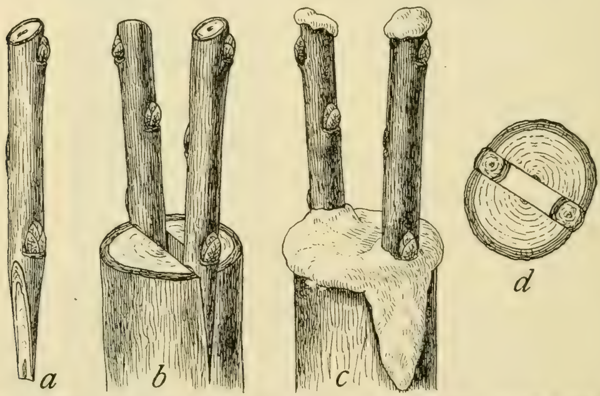

Fig. 129.—Cleft grafting: (*a*) scion; (*b*) scions inserted in cleft; (*c*) cleft graft waxed; (*d*) cross section of stock and scions.

selection of the branches to form the top. Scions when grafted always grow upward regardless of the former direction of the stock. This tends to produce a narrow, high-topped tree. Great care should be exercised, therefore, to select branches well away from the trunk and covering all the fruit-bearing surface. In top-working a matured tree, it will be necessary to graft a large number of branches, but only about one third of these should be worked in a single season. It takes from three to five years

to renew the entire top of a large tree. All the important branches should be grafted if the original fruit-bearing surface is to be maintained. This work is performed about the time the trees are ordinarily pruned in the spring, and just before growth starts. After the grafts are inserted in the cleft, all the exposed surface of the stock and tips of the scions are coated with grafting wax to keep the scions moist and to prevent decay.

Fig. 130. — Top grafting a young apple tree.

Inarching or Approach Grafting. — There are many plants that cannot be successfully grafted by any of the previous methods. Such plants can be more conveniently propagated by inarching. With this method, each plant remains attached to its own roots and the scion is detached only after the graft has united. To practice inarching, the plants must be grown near together or in pots, that it may be possible to bring them together and to unite the stock and scion without detaching them from the plants. The cambium layer of each may be exposed by any cut that will enable the two to come into direct contact when tied. In some plants a tongue is cut along the side of the stem of each; in others, as herbaceous plants, the outer bark is simply scraped to expose the cambium. It is important

that the two plants be tied in such a manner as to hold them perfectly rigid until the union is complete. Raffia or soft string is generally used for tying herbaceous grafts, and they are covered with sphagnum moss to keep them moist. The grafts of trees and shrubs are sometimes waxed. After the two plants have united the stock above the union may be pruned off and the plant originally producing the scion may be cut below the union. Potatoes may be grafted upon tomatoes by this method, and many greenhouse plants may be similarly propagated.

EXERCISES

1. Go out into an old orchard and dig away the soil from the trunks of the apple trees until the place where the root graft was made is disclosed to view. Note if there are any places where the wound did not heal and thus allowed the entry of disease-producing fungi. This will be shown by a decayed area.

2. Explain in detail the method of growing a Baldwin apple tree from unknown seed.

3. Make grafting wax according to the following directions: Weigh out 1 part by weight of tallow, 2 parts of beeswax, and 4 parts of resin. Pulverize the resin, cut up the beeswax and tallow and boil together slowly until all is entirely dissolved. Pour the mass into a pail of cold water and after greasing the hands, squeeze out all the water and pull like molasses candy until the wax becomes light colored. Be careful not to pour the hot mass into the water too quickly. The wax should be pulled until it is cool and then rolled into lengths and wrapped in paraffin paper until the next laboratory period. Grafting cord for binding grafts may be prepared by putting a ball of No. 18 knitting cotton into a kettle of melted grafting wax and allowing it to become thoroughly saturated.

4. Visit an apple orchard and collect twenty-five scions. Tie them into a bundle, and label with name of the variety, the date, and the collector's name. Pack away in a cool place in damp sand.

5. Collect the same number of bud sticks from peach trees. Label and store as in previous exercise.

6. The teacher should collect a number of willow sticks three eighths to half an inch in diameter sometime previous to this exercise and place them in a pail of water in a warm room to have them in such condition that the bark will slip readily for budding. With the peach bud sticks of the previous exercise at hand and the willow sticks as stocks the students should perform the operation of budding, learning the proper method of cutting the buds, making the incision, inserting the bud, and tying the same.

7. Collect a number of pieces of apple limbs one and a half to two inches thick and a foot or more long. Using these as stocks and with the apple scions previously collected each student should perform the operation of cleft grafting, until each becomes proficient.

8. Visit a neighboring orchard and select the branches that should be grafted in top-working the trees. Perform the work if possible.

HOME PROJECT

Plant about a hundred peach, apple, or plum seeds in the spring, and bud them at the proper time with standard varieties. Keep an accurate record in notebook of the date, method, and time spent in performing each detail of the work. Also note the time of sprouting after seeding, the number of seedling trees, and the number of buds successfully grafted.

CHAPTER V

FRUIT GROWING

Fruits are grown in nearly all parts of the United States. In many regions where the conditions of soil and climate are especially suitable, fruit growing has developed into a leading agricultural industry. Since some fruits may be grown successfully on nearly every farm, each farmer should possess the requisite knowledge and skill to produce enough first-class fruit for the table.

Selecting a Site. — In all fruit-growing regions and on nearly all farms there are certain sites best adapted to fruit growing. Most fruits demand a sloping site to give good soil and air drainage. Fruit trees will not thrive on poorly drained soil. A slope of four to five feet per hundred is generally sufficient. Air drainage is as important as soil drainage. Cold air is heavier than warm air and settles in the low spots; hence such places are more likely to be visited by the late spring frosts when the trees are in bloom, killing the blossoms and spoiling the crop. Sites that are too steep are also objectionable as it is inconvenient to cultivate, spray, and otherwise care for trees on very steep land.

The exposure of a site should also be considered. Fruits growing on a southern slope blossom early, while those on a northern slope, which is generally cooler and more moist, blossom later. In growing early crops where there

is little danger of late spring frosts, a southern slope is to be preferred, but in growing late varieties of fruits or those that require coolness and moisture, a northern exposure should be selected. Where the prevailing winds are from the west an eastern exposure is desirable, especially for such fruits as apples that drop their crop during severe wind storms. If the site is adjacent to a large body of water, the moderating influence would be most marked on the slope toward the water. There is no best exposure. Each grower should select a site that meets the requirements of the fruit he intends to grow under his local conditions.

The soil is also an important consideration in selecting a site. The essentials of an ideal soil for fruit production are good drainage, good texture, and a sufficient amount of plant food. Certain soils are better adapted to certain kinds of fruits than others. Apples prefer a medium clay loam while pears do especially well on a heavy clay loam; peaches and most other stone fruits, except plums, prefer a lighter soil; while the quince and most of the bush fruits do better on a medium heavy, cool, moist loam. Strawberries and grapes thrive best on a rather light soil. Fruits come into bearing earlier on light soils, but the trees are apt to be short-lived. On heavier soils, the trees usually grow larger and live longer. In the home fruit garden, however, almost any kind of fruit can be grown by observing good culture and tillage practices.

Planning the Fruit Garden. — In planning the fruit garden, it is advisable to draw a plan to a definite scale showing the relative arrangement of the fruits, the number of each to be grown, and the distance apart that they are to be planted. This not only serves as a guide at planting time, but also furnishes a permanent record of the position

and variety of each tree and permits the placing of the various fruits so as to secure the greatest economy of space.

For general market purposes, it is best to select few kinds with a sufficient number of each kind to market successfully, while in growing fruit for home use only a small number of each is required.

In arranging fruits in a garden, it is best to plant each kind by itself. When tree fruits are interplanted with small fruits, the cost of caring for them is increased. Pear trees are sometimes planted between apple trees, but it is often desirable to cultivate the apples when it may be inadvisable to cultivate the pears. Interplanting is often practiced in order to get quick returns from the orchard. Strawberries are often interplanted between tree fruits; thus the land produces returns the second year. Farm crops are often grown between the rows. Under such conditions, it is essential to provide a sufficient amount of fertilizer for both crops, otherwise this practice will stunt the trees. When intercropping is practiced, it is best to use some cultivated crop that the soil moisture may be preserved. Wheat, oats, and any of the grass crops are to be avoided.

Square System. — There are various systems of arranging trees in the orchard. The square system is the most common. In this the trees are planted in rows an equal distance apart each way and so placed as to be in alignment with the trees of the adjoining rows. This is the easiest system to lay out, and is a very convenient one to care for. Since two trees diagonally across from each other in a square are a greater distance apart than the ones on the same side of the square, it is evident that this system does not utilize space economically and does

not permit the planting of as many trees per acre as other systems.

Alternate System. — In this system, the first row of trees is planted as in the square system, but the trees of the adjacent row alternate with those of the first row. By this system, although the trees are not equal distances apart, the space is more evenly divided, but the trees do not line up both ways as in the square system.

The Hexagonal or Triangular System permits the planting of more trees per acre than the other systems and

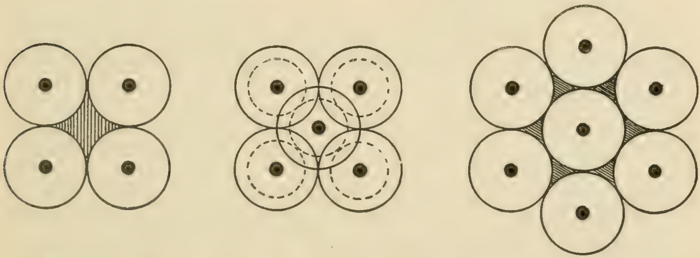

Fig. 131. — Square, alternate, and hexagonal planting plans for orchards.

equalizes the space to the best advantage. In this system each tree occupies a corner of an equilateral triangle.

Distances between Trees. — The distances apart that fruits should be planted depend upon the kind, variety, soil, locality, and system of culture to be followed. Apple trees grow larger than peach trees and hence must be given more space, if large, spreading, well-formed trees are desired. There is also often a great difference in the growing habits of different varieties of the same kind of fruit, as may be seen in comparing the Baldwin apple tree with the Wagener. The former develops to a large size, while the latter is a small-growing variety. Upon light

soil, trees seldom grow so large as upon strong soil, hence in some sections the same varieties are more vigorous in growing than in others. The systems of pruning, training, fertilizing, and cultivating that are to be practiced all influence the distance of planting.

The usual distances apart for planting fruits are as follows:

Apples	25 to 40 feet each way
Pears	20 to 30 feet each way
Plums	16 to 25 feet each way
Peaches	16 to 25 feet each way
Cherries, sour	16 to 25 feet each way
Apricots	16 to 20 feet each way
Quinces	8 to 14 feet each way
Grapes	8 to 12 feet each way
Currants	4×6 feet
Gooseberries	4×5 feet
Raspberries, black	3×6 feet
Raspberries, red	3×5 feet
Blackberries	4×7 to 6×8 feet
Strawberries	$1\frac{1}{2} \times 3$ or 4 feet

Selecting Varieties. — Since much of the fruit grower's success depends upon the quality and quantity of fruit he produces, his most important consideration is that of varieties. The most common mistake made in planting commercial orchards is that of selecting too many varieties. An orchard consisting of many varieties proves of little commercial value as there is not enough of any one kind to market with profit.

Many growers make the mistake of planting varieties not adapted to the locality. Some of our best varieties of apples are grown successfully only in certain localities.

while others are able to adapt themselves to a wide range of conditions. The Baldwin apple, the Bartlett pear, the Lombard plum, and the Elberta peach are cosmopolitan varieties; while the Spitzenburg apple, the Kalamazoo peach, the Bosc pear, and the Satsuma plum are examples of the other type. One of the best ways of learning the

Fig. 132. — Heeling-in young trees.

varieties adapted to a particular region is to visit neighboring orchards during the harvest season, and note the varieties producing the best crops.

New varieties are not desirable in commercial orchards. Standard varieties are well known and need little advertising. The public is aware of their merits. Novelties should be planted only to test their value, not as a commercial venture.

In selecting varieties for the home fruit garden, quality is the most desirable characteristic. The commercial fruit grower must carefully consider hardiness, productiveness, and shipping qualities. These are not so important to the home fruit grower.

Heeling-in. — When the trees arrive from the nursery, they should be unpacked as soon as possible and heeled-in. This consists in selecting a well-drained spot along the north side of a building, fence, or woods, and digging a trench large enough to accommodate the roots of the trees without crowding. The trees are then set in this trench, facing the north and slanting at an angle of about forty-five degrees. The soil is then packed firmly about the roots to keep them in a moist condition. At no time should the roots be exposed to the sun or drying winds. It is essential at planting time to keep them covered with soil, moist burlap, or in water until ready for use.

The Time for Planting. — The spring is usually the best time to plant an orchard. In some localities, fall planting is also successful, but if a severe winter follows, the trees are liable to injury from freezing. If spring planting is practiced, it is desirable to get the trees set as early as the ground can be worked. The cool moist spring days permit the tree to become established before the warm dry summer sets in.

Preparation of Soil. — The method of preparing the soil depends upon its nature, texture, and fertility. If the land is in sod it is a good plan to plant it with some cultivated crop for a season or two before setting the trees. This brings the soil into a uniform and mellow condition. If the soil is shallow or contains a stiff hard pan near the surface, this should be loosened up as deeply as possible

with the plow. If the soil is light and poor, a heavy coating of manure before plowing will prove very beneficial. Land for orchard planting should be prepared deeply and thoroughly, as it is much more difficult and expensive to improve a soil after the trees are set.

Laying out the Orchard. — For the small orchard, the trees may be located by stretching a line or wire across the field where the first row is to be planted and marking off proper distances on the wire with white string or cloth. After the stakes have been set at these points for the first row, the line is moved to the next and the process continued.

If the area is large, it is well to establish a base line along one side of the orchard with stakes marking the position of the rows. Another line should be run along an adjacent side at right angles to this base line and stakes set along it at the distance of the trees in the rows. If similar lines are marked off along the other two sides of the orchard, the correct location of any tree may be determined by sighting.

Planting the Trees. — This is generally done with the aid of a planting board. This board should be four or five

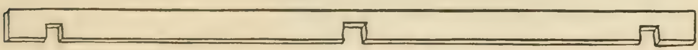

Fig. 133. — A planting board.

feet long, about three inches wide, and a half inch thick. A square notch is cut out of the center and at each end along one side of the board. The board is so placed that the stake marking the position of the tree fits into the center notch and a stake is driven in each notch at the ends. The center stake is then pulled up and the board, after the hole is dug, is replaced against the two outside stakes.

The tree is then set in such a manner that its trunk comes through the center notch in perfect alignment.

In planting large orchards, furrowing along the tree rows is often practiced. The holes are cleaned out by hand. As a rule the harder the soil, the larger the holes should be dug. When the soil has been well prepared, the hole need only be large enough to receive all the roots of the tree without twisting or crowding. If the top soil is shallow and the subsoil hard, the bottom of the hole should be loosened. A very objectionable practice is that of throwing coarse or fresh manure into the bottom of the hole. While these materials are decomposing, they absorb moisture and cause heating which is injurious to the roots of the trees. It is a better practice to separate the rich surface soil from the subsoil when digging the hole and to use only the best soil in the bottom of the hole, packing it firmly about the roots, being careful that no air spaces are left, especially beneath the crown.

Fig. 134.— Planting young orchard trees. Note how the hands are used in packing soil around the roots.

When the young tree is dug from the nursery, much of the root system is removed, so that at the time of planting the roots will be found with broken and ragged ends.

These should be trimmed off with a sharp knife, making a clean cut that will heal readily. In planting, one man should hold the tree with one hand and pack the soil well about the roots with the other, using his fingers for pushing the soil under the crown and between the roots and finally tramping it down firmly with his heels; while another shovels the soil into the hole. If the soil is not too wet, there is little danger of packing it too firmly. It is a common mistake to leave the soil too loose about the roots. The poorer soil may be finally used on top, the upper surface of which should be left loose to prevent the loss of soil moisture. If it is desirable to use fresh or strawy manure, it is a good plan to mulch the top of the soil with it, but well-decomposed manure may be thoroughly mixed with the soil before planting. If the planting is done in the fall, the soil should be banked up for at least a foot around the tree to prevent the wind from loosening it during the winter, and also to provide surface drainage and protection from mice. Care and attention in the first planting of the tree is more economical than resetting.

Care of Trees the First Season. — The season directly after planting is the most critical period in the life of a tree. Whatever system of orchard management is finally adopted, everything should be done the first season to enable the trees to make a strong vigorous growth. If tillage is practiced, it should be done thoroughly and often, as it not only conserves soil moisture, but accelerates the chemical action of the soil, making plant food more available. If mulching is practiced, a heavy application of straw or manure should be given, spreading it out a good distance from the trees. Cultivation or mulching with manure or

straw will also kill all weeds which might in their growth absorb much soil moisture and plant food.

Although too much growth can hardly take place the first season, it is well to cease cultivation about the first of August so that the trees may have an opportunity to mature their new wood and harden it before winter. Generally a cover crop is sown at this time, which absorbs much of the plant food that might otherwise wash away or leach through the soil. The trees should be carefully watched for climbing cut worms, San José scale, leaf curl, and webworms. If all insects and diseases are checked as soon as they appear, little injury will result, but carelessness in these matters may prove fatal to young trees.

In addition to cultivation, it is frequently advisable to feed the trees after planting to enable them to gain a good start. Of all the fertilizers that are used for this purpose, well-decomposed stable manure is the best general fertilizer, and should be applied early enough so that the trees may receive the benefit of it during their early spring growth. Nitrate of soda is sometimes used to stimulate growth. This fertilizer should not come in direct contact with the roots. Being very soluble, it is advisable to make two or three light applications rather than one heavy one. As a source of potash, unleached hardwood ashes or muriate of potash may be used. Some forms of phosphate, as acid phosphate, may also prove beneficial.

EXERCISES

1. How many acres of your farm are adapted to fruit growing?

2. Describe a near-by site that would be ideal for an orchard.

3. Name the best winter apple to grow in your locality; name the best summer and fall varieties for your locality.

4. With Baldwin apples planted 36 feet apart each way, how many trees will be required to plant an eight-acre field by the square system with the side and end rows 18 feet from the borders of the field? How many trees will be required to plant this area by the hexagonal system?

5. What is the reason for packing the soil firmly about the roots when planting trees?

(*To the Teacher:* The class may be divided into squads of three to five students, and each squad assigned a piece of land on which to plan, stake, and plant out an orchard of at least ten trees. One-year-old seedling peaches may be grown or purchased very cheaply for this work. Each squad should make its own planting board.)

HOME PROJECTS

1. Set out an orchard of at least ten trees on the system most desirable for your conditions. When planting the trees, fertilize them by mixing the soil with well-rotted manure or by applying fresh manure on top as a mulch.

2. Make an orchard survey of the tree fruits within a radius of one mile of your home. Tabulate your facts as follows:

(*a*) Total number of orchards.

(*b*) Total number of trees.

(*c*) Total number of each kind of fruit trees.

(*d*) Total number with good soil drainage. Average condition of trees.

(*e*) Total number with poor soil drainage. Average condition of trees.

(*f*) Total number with good air drainage. Average condition of trees.

(*g*) Total number with poor air drainage. Average condition of trees.

(*h*) Number of each kind with northern exposure. Average condition of trees.

(*i*) Number of each kind with southern exposure. Average condition of trees.

(*j*) Number of each kind with eastern exposure. Average condition of trees.

(*k*) Number of each kind with western exposure. Average condition of trees.

(*l*) Number of each kind on sandy soil. Average condition of trees.

(*m*) Number of each kind on sandy loam. Average condition of trees.

(*n*) Number of each kind on clay loam. Average condition of trees.

(*o*) Number of each kind on stiff clay. Average condition of trees.

CHAPTER VI

ORCHARD MANAGEMENT

FRUIT trees will not produce profitable crops when left alone to struggle for their existence. Good fruits are produced only when the trees are supplied with an abundance of food and moisture.

Cultivation. — Cultivation aërates the soil, improves its texture, and makes plant food available. It also deepens the top soil, and increases the feeding area of the roots. The practice of plowing the soil in the spring and harrowing it frequently during the growing season is followed by many successful growers. This is known as the soil-mulch system. By stirring the soil and keeping the upper surface loose and friable, soil moisture is maintained and the growth of weeds prevented. As this is the cheapest method of maintaining soil moisture and of feeding the trees it is usually the most desirable practice. As early in the spring as the land can be worked a cover crop should be turned under and the soil smoothed down with a harrow. Every week or ten days, and after every heavy rain, the land is again harrowed to keep the top soil fine and loose. This is continued until late summer, when a cover crop is sown and left until the following spring.

Some growers find it better to practice the sod-mulch system. Where the land is unusually fertile and moist, good fruit may be grown by this system. On farms where the fruit crop is not the principal money crop or where the land slopes so that cultivation cannot be practiced without

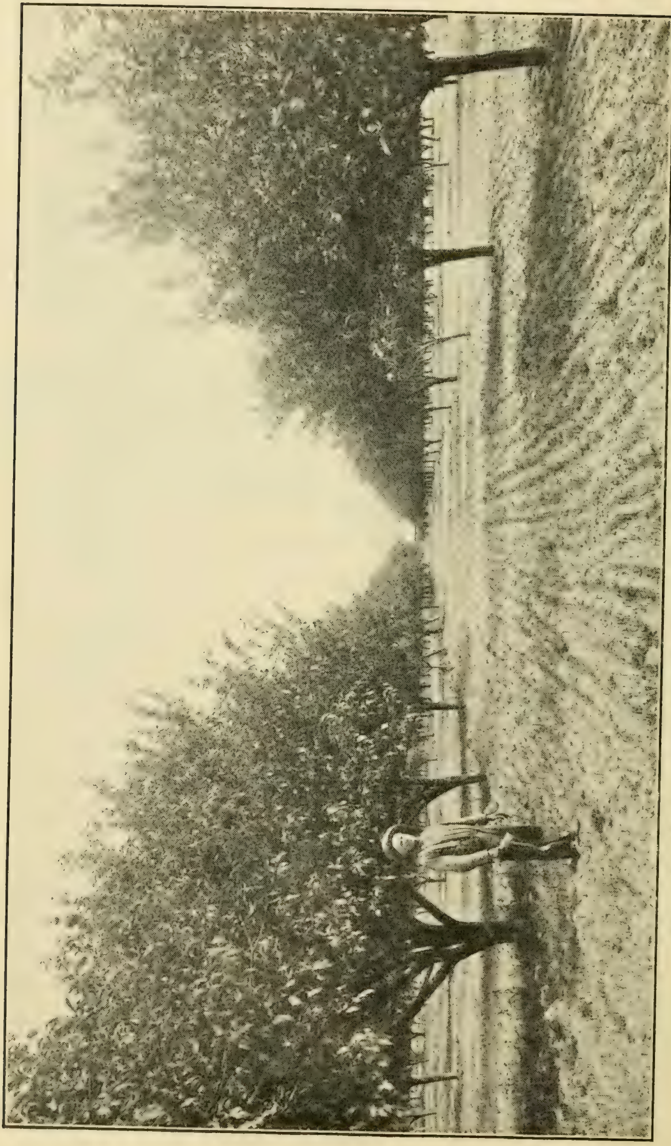

Fig. 135. — A well-cultivated apple orchard. Note the thrifty condition of the trees.

severe washing, this system is advisable. Here the grass is cut three or four times a year, and left on the ground or raked under the outer branches of the trees. It thus serves as a mulch to prevent the loss of soil moisture. It is frequently necessary, however, to apply additional straw or coarse manure. Since the plant food on this system is not liberated so rapidly in the soil, it generally becomes necessary to fertilize more heavily than where the soil-mulch system is practiced. In planting trees, the sod should be turned under for a considerable distance around the trees and a heavy coating of straw applied until they have grown sufficiently to shade the ground beneath.

Maintaining Fertility. — Maintaining fertility is one of the serious problems that confront the fruit grower. The general farmer keeps stock enough on the farm to supply fertilizer for his land, but the fruit grower without live stock must find some other method of maintaining the fertility of his fields. Unlike the annual crops of the farmer, a fruit tree grows for years on the same site, drawing the same kind of plant food from the soil.

The purchase of plant food in the form of commercial fertilizers is expensive. The cheapest source of fertilizer for the fruit gardener is the soil itself, but often this plant food is in an unavailable form. Tillage lets in the air and promotes the activity of the soil. It is the cheapest way of making plant food available.

It is not always sufficient to improve the fertility of an orchard by tillage alone, but it will help much in reducing the amount of fertilizer that need be furnished. When an orchard has been in sod for a number of years, its growth may be stimulated by breaking up the sod and thus liberating plant food.

Cover Crops. — Most trees produce their new growth from the time the buds open in the spring until midsummer. It is therefore essential that the plant food be available at this time. Plowing, harrowing, or disking the soil early in the spring and keeping it well cultivated until midsummer promotes this condition. To cease cultivation about midsummer tends to stop the growth of wood and causes it to ripen and harden for winter. The practice of sowing some crop on the soil about midsummer to be later turned under is called "cover cropping."

Functions of Cover Crops. — The relation of cover crops to tree growth has already been explained. Their relation to soil fertility is also important. A soil that is kept constantly cultivated soon loses its humus and consequently its mellowness and friability. To maintain the texture of the soil, it is necessary to have plants decaying in it at all times. When orchards are cultivated, this annual loss of plant fiber to the soil must be replaced. The practice of cover cropping generally proves to be the most economical method. Under this system the soil grows its own crops, produces its own humus, and thus maintains its own texture. When plants are plowed under in the spring, they soon decay and the plant food that they contain is liberated and becomes available at a time when the trees most need this food.

Light sandy soils and many of the clay soils are generally low in nitrogen. Cover crops may be used to add nitrogen to the soil. When a soil is low in nitrogen, those plants that have the power of taking nitrogen from the air should be sown. For this purpose clovers, vetches, peas, and beans are sown.

Cover crops prevent weed growth, and on sandy soils

absorb plant food that might otherwise leach away. These food elements are stored in the form of plant tissues during the fall and winter and are returned to the trees in the spring after decay begins.

In orchards upon sloping sites, cover crops prevent washing. They also hold the leaves and snow, and produce a matting over the soil that is often extremely valuable in preventing deep freezing and winter injury.

Choice of Cover Crops. — In some orchards it is desirable to disk the land in the spring, hence a cover crop should be

Fig. 136. — Sweet clover as a cover crop in a cherry orchard.

used that can be easily worked into the soil at that time. Under these conditions, oats, buckwheat, peas, barley, or turnips are often used.

When the trees are producing a weak growth, some legume as winter vetch, crimson clover, mammoth clover, peas, or soy beans should be sown. But when the trees are growing too rapidly or making too much wood at the expense of fruit production, these plants should not be used. Rye, oats, or some other non-legume should be grown.

The locality of the orchard has much to do with the kind of cover crop grown. Crops adapted to special conditions of soil should also be selected. Vetches thrive best upon sandy lands while clovers do well on a clay soil.

Certain crops are frequently combined as cover crops. Oats and Canada peas, rye and winter vetch, buckwheat and clover, and turnips and clover are desirable combinations.

An ideal plant for a cover crop is one that starts to grow quickly and with which it is not difficult to secure a uniform stand. It must produce a fair amount of growth in late summer and be able to withstand tramping during the picking season. If the plant is one that lives through the winter, it must start to grow early in the spring.

QUANTITIES OF COVER CROP SEED TO SOW PER ACRE

Legumes		Non-Legumes	
Winter vetch	25 lb.	Rye	48 lb.
Spring vetch	90 lb.	Oats	2 bu.
Mammoth clover	20 lb.	Buckwheat	¾ bu.
Crimson clover	20 lb.	Turnips	2 lb.
Sweet clover	15 lb.		
Cowpeas	90 lb.		
Velvet beans	25 lb.		
Soy beans	90 lb.		

Plowing under Cover Crops. Cover crops should be turned under as early in the spring as the soil can be worked. Then the plant tissues are soft and decay readily after being turned under. If the cover crop is allowed to reach large size before plowing much soil moisture is lost by transpiration from the growing plants.

Barnyard Manure. — Where a sufficient amount of barnyard manure is obtainable at a reasonable price, it may be profitably utilized in the orchard. Barnyard manure is a complete fertilizer and acts in two ways, — directly by adding plant food, and indirectly by adding humus to the soil. Rank-growing trees should not be fertilized with barnyard manure, but where the trees are weak and the foliage is yellow, it proves most beneficial. It may be applied to the orchard at almost any season of the year, but most advantageously in early spring, when there will be less waste by leaching and washing. Its effect upon orchard trees is more lasting than that of commercial fertilizers. A good dressing of it once every two or three years is sufficient.

Commercial Fertilizers. — The function of commercial fertilizers is to supply the kinds of plant food that are deficient in the soil and that are necessary for producing profitable crops. Nitrogen, phosphoric acid, and potash are called the essential fertilizers because they are the ones that are likely to be present in but limited amounts in the soil.

Nitrogenous fertilizers promote a vigorous growth of both twigs and foliage. Nitrate of soda is used when it is desirable to apply a fertilizer whose nitrogen is quickly available. It should be applied only when the trees can take it up immediately, as it is very soluble in water and hence apt to leach away. Sulphate of ammonia has much the same value and effect as nitrate of soda. Cottonseed meal, dried blood, tankage, and fish scrap are used more in producing crops that have a long growing season, since the nitrogen which they contain is more slowly available.

Phosphoric acid promotes fruit production and the

development of a matured hardy growth. Bones and phosphate rocks are the chief sources of this element. When these are treated with sulphuric acid, the product is called acid phosphate.

Potash induces the formation of a well-matured growth and high-colored fruit. Muriate of potash, sulphate of potash, and wood ashes are the most common sources of this fertilizer.

Commercial fertilizers are generally applied to the orchard with a fertilizer drill or by broadcasting and harrowing them into the soil. This should be done in the spring soon after the trees have started their growth. It is a mistake to fertilize a fruit tree only near the base of the trunk. The feeding roots of a bearing tree are nearly all under the outer branches and between the rows. This is the place where the fertilizer should be applied.

In maintaining the fertility of an orchard, it is seldom advisable to depend entirely upon commercial fertilizers. They should be used not to replace tillage, green manures, or barnyard manures, but rather to supplement them. It is only on soil of good texture supplied with plenty of humus that the best results with commercial fertilizers can be obtained.

Pruning. — The productiveness of an orchard depends largely upon the skill and attention that is given to pruning. Each tree in an orchard has only as much top growth as its roots can support. The fruit grower desires a vigorous top that will produce the largest and best fruit. Pruning induces this vigor by concentrating the growth into less wood. Many farmers judge the thoroughness of their work by the size of the pile of prunings they have under their trees. Severe pruning induces the growth of water

sprouts. This is because the tree endeavors to restore the natural balance existing between the top and the root system. It takes a tree two or three years after a severe pruning to become productive again. The first important rule of pruning is to prune regularly and lightly.

Fig. 137. — Pear tree after planting. Before and after pruning.

Pruning has two important functions: (1) to modify the vigor and fruitfulness of the tree, and (2) to secure a tree of such form as to produce fruit most economically. The latter function is of great importance. During the earlier years pruning consists largely in shaping the tree so that the spraying, thinning, and harvesting may be most easily performed.

The height from the ground at which the branching should begin varies with the different kinds of fruits and with the various localities in which they are grown. In some sections, peaches are pruned so that their heads are formed but a very short distance from the ground, while in other places they are started a foot and a half to two and a half feet from the ground. In general, apples are so pruned that their heads are formed eighteen inches to three

and a half feet from the ground. In sections of the country where the trees are subject to sun scald, it is the practice to start the heads lower, so that the tops may shade the trunks. Pruning, spraying, and harvesting may all be performed economically upon low-headed trees.

Fig. 138.— A bad crotch, which will easily split.

Many trees have their heads formed when received from the nursery. In such cases, four or five of the strongest branches should be selected to form the future framework of the tree. These should be distributed over at least fifteen inches of the trunk and extend in all directions. No two of them should be on opposite sides, as this produces a crotch which will easily split when heavily loaded with fruit. All other branches should be removed and the main limbs cut back a third to a half their length. At the end of the second season's growth, each of these scaffold limbs will have produced two or more lateral branches. These in turn should be carefully selected and headed back in order to produce a top with evenly distributed branches. It is well to remember that during the first three years, the weaker portions of the tree must be filled out. After this time there will be little pruning to do until the tree comes into bearing, except to cut out branches growing in the wrong direction.

In pruning bearing trees, the object is to produce vigor and fruitfulness. All dead branches should be removed and others thinned where crowded, as high-colored fruit cannot be produced without sunlight. A good circulation of air through the tree is desirable in the production of clean, healthy fruit. All branches of a tree should grow outward like the spokes of a wheel. When they cross and interlace they steal the space allotted to each other, and as they enlarge they rub and chafe each other.

One should endeavor to keep the tops of the trees from growing too high, so that the fruit may be sprayed and harvested without difficulty. Hence, in pruning bearing trees, it is frequently necessary to cut back the tops a short distance and also to open up the center of the tree to let

Fig. 139. — An apple tree before pruning.

Fig. 140. — The same tree after pruning.

in the light and air. Severe pruning in this manner, however, will frequently cause serious damage from sun scald.

Although trees may be pruned at almost any season of the year except when the sap is flowing, early spring is usually the best time. Pruning during the dormant stage stimulates growth, while summer pruning seems to weaken

the trees. Pruning may be performed at any time during the fall or winter, but the wounds do not start to heal until spring.

All trees should be pruned in such a manner as to prevent decay and to preserve sound trunks. This is accomplished by cutting the branches in such a way that they will heal readily. The living and growing part of a tree is the cambium layer that lies just beneath the bark. All the new cells are produced in this tissue, some of them being pushed outward to produce the bark, while those on the inside become the wood tissue. When a branch is removed, healing tissue is produced in this cambium layer and gradually grows over the wound. This protects the wood cells beneath it from the fungi and bacteria that cause decay.

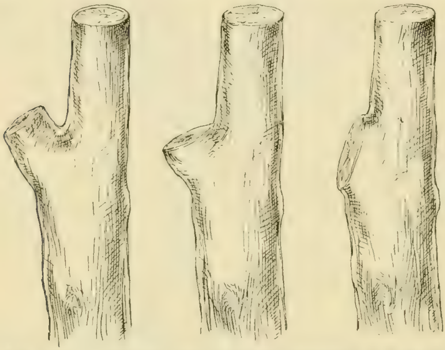

Fig. 141. — Proper and improper removal of a large limb. The trunk on right shows the proper method.

To hasten the healing of wounds all branches should be cut as close to the trunk or branch as possible. In pruning twigs it is also better to prune to a bud, — that is, to cut the twig just above a bud, — which draws the sap to the wound. If a limb is cut eight or ten inches beyond the trunk, the wound does not heal readily and when a stub becomes decayed the disease travels down through the heart of the tree, causing a hollow trunk. Such a tree blows over easily during a heavy storm. To protect

wounds larger than an inch and a half in diameter from decay, it is well to paint them. Raw linseed oil and pure white lead mixed to a thick paste make the best paint for this purpose.

In pruning large limbs in which there is danger of the weight of the branch stripping the bark before the limb is entirely sawed off, a cut is made on the under side of the branch about a foot from the trunk, by sawing about a third through the branch. The branch is then sawed off from the upper side a short distance beyond this point. The stub is then pruned away close to the trunk without danger. The cleaner the cut, the more quickly it will heal, hence in pruning large branches, it is advisable to trim the cambium layer with a sharp knife after the branch is sawed off. Tools that make sharp, clean cuts rather than jagged wounds should always be used in pruning.

EXERCISES

1. Name the two mulching systems and give the advantages of each.

2. Is the practice of cover-cropping common in your locality? What kinds of cover crops, if any, are used?

3. Obtain roots of vetch, mammoth clover, peas, and beans, and observe the nodules in which live the bacteria that have the power of taking nitrogen from the air and giving it to the nodule-bearing plants.

4. How much seed would it take to sow a cover crop of winter vetch in an orchard 384 feet long and 256 feet wide? When should it be seeded and when should it be plowed under?

5. How are orchards usually fertilized in your section? Are commercial fertilizers used?

6. What is the effect of nitrogen on plant growth? How do potash and phosphoric acid affect fruit production?

HOME PROJECT

Prune six trees of a bearing orchard as directed in the text. Describe in spaces the condition of the trees before pruning; the approximate number, size, and position of the branches removed; your reasons for so doing; and the time required to prune each tree. Note the results of your work on the character and size of the new growth, the color, size, and quality of the fruit. What conclusions can you draw as to the necessity, amount, and character of pruning the trees require?

CHAPTER VII

FRUIT PESTS

THERE are few sections where fruit may be grown without protection from insects and diseases. Each year new pests appear and the older a fruit section becomes the more numerous are its insects and diseases.

INSECT PESTS

From a horticultural standpoint, the insects with which a fruit grower has to contend may all be grouped under two heads, — the chewing insects and the sucking insects.

Fig. 142. — Section of a wormy apple. Codling moth and cocoon.

Chewing Insects. — The chewing insects actually eat or chew some portion of the plant. The tent caterpillar eats the foliage, and the "worm" of the codling moth chews the fruit. As a rule, such insects are most easily controlled by poisoning their food. Arsenic is the poison usually used. The most common commercial forms of this poison are Paris green and arsenate of lead.

Codling Moth. — The codling moth, a small grayish-brown moth, attacks apples, pears, and quinces. It causes the fruit to ripen prematurely and fall to the ground. This insect probably does more damage to the fruit than any other. About the time the young fruits are beginning to form, the adult insect flies about the orchard laying its eggs. Each egg hatches into a worm that eats its way into the fruit, usually through the calyx, where it lives until mature. The insect leaves the fruit at this time and finds its way to some protected place where it forms a cocoon and later changes to a moth.

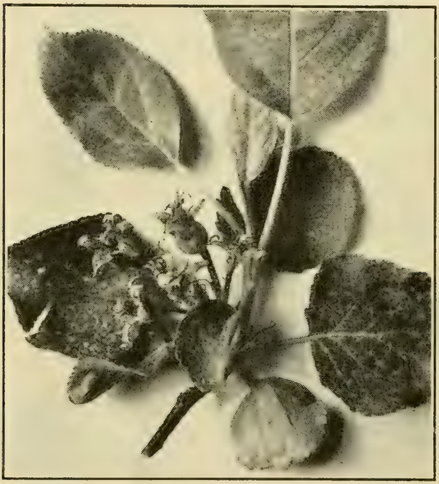

Fig. 143. — Time to spray for the codling moth — just after the petals have fallen and before the calyx lobes close.

The codling moth is controlled by spraying with arsenate of lead or some other arsenical poison. This should be applied immediately after the petals have fallen so that

the poison will reach the small calyx before the worm enters the fruit. As the time of hatching is somewhat prolonged, it is advisable to spray again in ten days or two weeks. In many sections of the country there are two or more broods of the codling moth in one summer, and under these conditions it is necessary to repeat the spraying at the times of the succeeding broods, the exact times varying with the season and locality. The worms of the last brood are the ones seen when the winter apples are harvested. Many of them leave the fruit while in storage and form their cocoons on the sides of crates, barrels, or other storage receptacles.

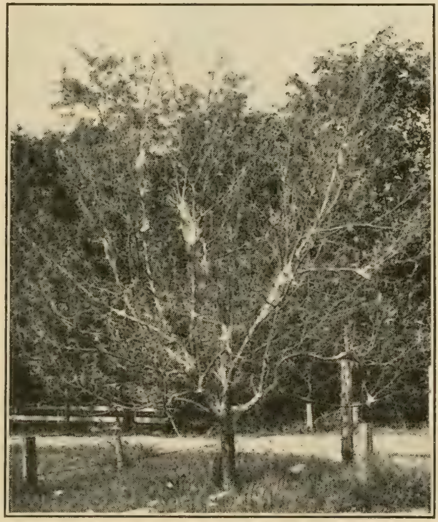

Fig. 144. — Webs of a tent caterpillar on an apple tree.

Cankerworm. — The cankerworm feeds upon the foliage of apple trees, often entirely stripping them of leaves. The worms are brownish and about an inch long when fully grown. They lower themselves to the ground by means of a fine thread.

Cankerworms are controlled by spraying with an arsenical poison applied as soon as the worms are seen. Arsenate of lead applied as soon as the leaves are formed in the spring, usually controls them. Where the fall cankerworm is troublesome, use the same spray in the fall.

Tent Caterpillar. — The tent caterpillar forms a web-like tent in the crotch of the branches. The insects leave this protection at certain times of the day to feed upon the foliage, returning to the tents at night. The young caterpillars, which hatch in the spring just as the leaves open, are voracious eaters. Unless controlled, they will soon strip an infested tree of its foliage. They are especially fond of the foliage of apples and cherries. They grow very rapidly until matured, when they are about two inches long.

The tent caterpillar is easily controlled by spraying the foliage with arsenate of lead or Paris green. If the trees are not sprayed, the tents formed are readily seen and should be cut out or destroyed when the worms are still inside.

Webworm. — The webworm is often mistaken for the tent caterpillar, but it differs from the latter in appearing later and in forming its web over its feeding surface rather than simply in the crotch of the branches. The fall webworm, which is most common, usually appears in July or August.

This insect may be easily controlled by pruning and burning the webs when they first appear, and while they are still small. If not controlled the web enlarges and covers large branches which the worms defoliate.

Plum Curculio. — This is the worst enemy of plums and often attacks cherries. The mature beetle is about a quarter of an inch long, grayish-brown, with two conspicuous humps on its back, and feeds slightly upon the foliage. It has a long snout with which it cuts a crescent-shaped hole on the surface of a young hard fruit in which it deposits its egg. The white grub, which hatches from the egg, eats

its way towards the center of the fruit, eventually causing it to drop. Sometimes it also stings the fruit of the apple, pear, and quince, causing the formation of knotty fruit. The apple curculio also works in a similar manner.

Regular spraying with arsenical poison is generally effective in controlling these insects. When the beetles are very numerous they may be quickly reduced by jarring the trees very early in the morning, beginning soon after the fruit begins to set. The larger branches are knocked with a padded pole and the curculio curls up when it feels the sudden jar, drops to the ground, and may be caught on a white sheet spread beneath the tree.

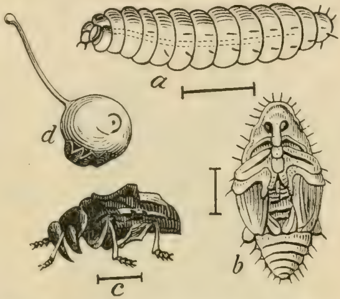

Fig. 145. — Plum tree curculio. *a*, larva; *b*, pupa; *c*, mature beetle; *d*, curculio on young plum.

Sucking Insects. — The sucking insects do not chew or eat any portion of a plant, but with their long tubular mouth parts they pierce its surface and suck its juices. Plant lice and scale insects are common examples of this group. It is impossible to poison their food by spraying with arsenical poisons. In dealing with such insects, it is necessary to use a contact spray; that is, one that will kill when it strikes the body of the insect. The most common spray of this class is the lime-sulphur spray used against the San José scale. Various tobacco extracts or nicotine sprays used in killing plant lice are also examples of contact sprays. Sucking insects are very difficult to destroy as it is necessary to hit each insect with the spray. Therefore, thoroughness in spraying is essential to success,

since the insects are extremely small and every portion of the plant must be covered.

Plant Lice or Aphids. — Plant lice usually appear on the foliage or young growths in the spring and early summer. Some seasons they are more prevalent than others. These insects suck the plant juices, causing the leaves to curl and become distorted. The green aphid attacks the apple, pear, and plum trees, while the common black aphid works on the cherry. The eggs are laid on the branches of the trees in the autumn, hatch in the spring, and the lice locate upon the young shoots. The woolly aphid attacks both the branches and roots of the apple and is distinguished from the others by having a conspicuous woolly covering. The root-inhabiting variety of this insect does the most injury. Infected roots become contorted and the tree sickens or dies.

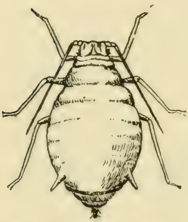

Fig. 146. — An aphid.

If the foliage is infected, it should be sprayed with nicotine or strong tobacco tea before the leaves curl. The root aphid is destroyed by the use of tobacco dust, four to six handfuls of which should be spread on the soil and thoroughly worked into it. The ends of the shoots of young trees should be dipped into a pail of tobacco water.

San José Scale. — The San José scale is the most dangerous insect pest of the orchard. All our common fruit trees are subject to its attack as well as many of the small fruits like the currant and gooseberry. It is found upon the branches, leaves, and fruit of the tree and is usually first discovered on the fruit during the harvesting period. Here it causes red, circular discolorations, in the center of which are the black scales. The insect is exceedingly dif-

ficult to detect on the branches unless badly infected. The tiny yellow body is completely covered with a single small dark scale not so large as the head of a pin. The dead scales are gray in color. When rubbed off they leave white circular spots, and cause badly infected branches to have a rather grayish appearance. This scale multiplies very rapidly and with its tube-like mouth parts it pierces the surface of the plant, sucking the juices within. If not controlled, it will kill large fruit trees in a few years.

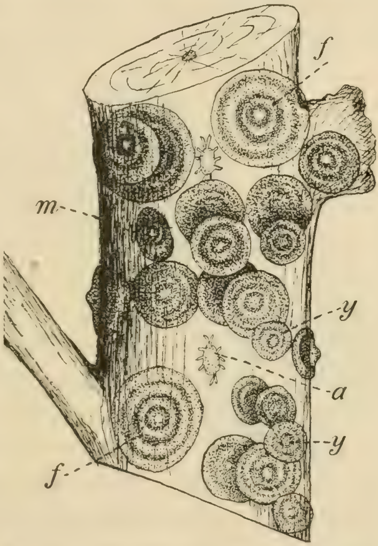

Fig. 147. — San José scale insects. Enlarged. *m*, male scale; *f*, female scale; *y*, young scale; *a*, young insect.

In infected regions, trees must be sprayed each year. The application of strong lime-sulphur spray applied early in the spring just before the buds open is now the standard method of control. It is necessary to spray the trees while they are dormant to permit the application of a spray strong enough to kill the insect without injuring the trees. As this is a contact poison, thoroughness is of prime importance, for a small number of insects left untouched will cause serious infection the following season.

Borers. — Borers are injurious to peach and apple trees. They usually infect the trunks of the trees just above the ground. They cannot be controlled by spraying, as the

poison cannot be placed where it will be effective. Many kinds of washes have been recommended, but few of them prove satisfactory. The fruit grower usually examines his trees every spring and fall, and digs out all borers that he finds working in the trunks. The soil should be removed from the base of the tree about a week or two before digging out the borers. Their presence will then be indicated by fresh castings.

FRUIT DISEASES

The fruit grower has to contend also with plant diseases. These may be classified under two heads, — fungous and bacterial diseases.

Fungous Diseases. — A fungus is a plant living upon other plants. It contains no chlorophyll and, therefore, cannot manufacture food for itself, hence it must live by appropriating food from other plants. Some fungi live upon the fruit, others upon the foliage, and others upon the bark of the branches, while still others live upon two or more parts of the tree. Nearly all scabs, smuts, mildews, rots, and blights are fungous diseases. For the control of these it is well to know something of their life history. Fungi reproduce by means of minute spores, which are somewhat similar to seeds. These spores, carried by the wind, insects, or rain, alight on the surface of a leaf or fruit and if conditions are favorable germinate there. Most spores will not germinate unless moisture is present. The spores upon germinating produce small rootlets which penetrate the surface of the leaf or skin of the fruit and spread from cell to cell in every direction, feeding upon the tissues within. When a fungus has reached this stage, it is impossible to destroy it with a spray, since

it is within the tissues. In a short time, the fungus bears fruit by sending up above the surface many small stalks which bear thousands of other microscopic spores, which are afterwards carried to other portions of the plant and to other plants. This is a typical example of the life history of a fungus. It shows pretty clearly that common fungous diseases must be controlled by spraying before the spores germinate. Spraying is a preventive measure rather than a cure. We cannot cure potatoes after they have been blighted or apples after they have been affected with scab, but we can prevent the spores from spreading to others. Bordeaux mixture and lime-sulphur solution are the two most effective sprays for controlling fungous diseases.

Fig. 148. — Pear scab on leaf and fruit.

Scab. — This is one of the most common fungous diseases of apples and pears, especially in wet seasons. It is most apparent upon the fruit, causing brown or black blotches with whitish edges. When the disease becomes excessive, it cracks the fruit and causes it to be misshapen. It also occurs as brown spots on the leaves and causes them to turn yellow and fall. Sometimes this disease attacks the young blossom stems and girdles them, causing the young fruits to fall. Some varieties, like the Snow apple and Flemish Beauty pear, are more susceptible than others.

Scab may be controlled by spraying with Bordeaux mixture or dilute lime-sulphur spray. These should be applied just before the blossoms open and again after the petals fall. When the weather is moist and warm, a condition favorable for the development of this disease, additional sprayings may be necessary. Plowing under early in the spring, the dead leaves on which the spores have rested over winter, is beneficial in controlling the disease.

Brown Rot. — This disease attacks the stone fruits such as peaches, cherries, or plums about the time of ripening, causing them to decay quickly. Infected fruit, allowed to remain on or under the tree, carries the spores over winter. During warm, moist weather, this disease develops very rapidly.

There is no cure for the disease when it develops suddenly at the harvesting time. It may be prevented, however, by spraying with lime-sulphur or Bordeaux mixture after the fruit is set, and two or three times later at intervals of about two weeks. As most of the stone fruits are susceptible to injury by spraying, the dilute lime-sulphur spray is preferable. On peaches and Japanese plums the self-boiled lime-sulphur spray should be used. All infected fruit should be picked from the trees during harvesting and carried from the orchard. Thinning will also help to prevent the spreading of this disease, if it develops during the ripening season.

Bitter Rot. — This is a more serious disease of the apples in the South and Middle West than in the more northern states. It forms cankers on the branches and makes a brown, decayed place on the fruit. The decayed area is very bitter and usually extends to the core.

Bordeaux mixture sprayed as recommended for scab

usually controls this disease. When the disease is very bad, additional sprayings later in the season are necessary. The cankered areas on the limbs should be cut out and burned.

Shot-hole Fungus. — This fungous disease of cherries, plums, peaches, currants, and gooseberries causes round, brown spots on the foliage, which later drop out, leaving the leaves full of holes. When the disease is severe, the leaves turn yellow and fall, thus preventing a vigorous growth of the tree and the formation of strong fruit buds for the succeeding year.

The foliage should be sprayed with dilute lime-sulphur before blossoming, after the blossoms fall, again two weeks later, and sometimes an additional spraying is necessary. For currants and gooseberries, the third spray should be omitted until after the fruit is harvested.

Fig. 149. — Peach-leaf curl.

Peach-leaf Curl. — This is a common disease on the foliage of the peach, causing the leaves to become curled, puckered, puffed over, and reddish in color. If not controlled, the foliage will drop.

The spores of the disease are carried over winter on the buds and on the twigs, hence it is necessary to spray with a fungicide just before the bud scales open. If the trees are sprayed with lime-sulphur in the spring for the San José scale, no additional spraying is necessary.

Black Knot. — The large black swellings that are frequently seen on the branches of thė plums and sour cherries are caused by the black-knot disease. It attacks the young twigs first and works its way down into the larger branches, finally killing the tree, if not controlled.

To control this disease, remove all infected limbs by cutting several inches below the knot, and then burn. Paint all

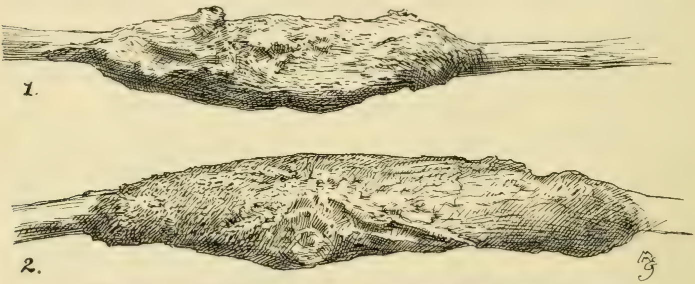

Fig. 150. — Development of black knot on young branches.

large wounds made in removing infected branches. Spray the trees as directed for brown rot, and remove all wild cherry trees and neglected plum trees about the garden. It is not a serious disease, if controlled. Every spring the trees should be carefully examined and all infected branches cut out.

Bacterial Diseases. — Some of the most serious diseases of fruits are caused by bacteria. Fire blight, a common disease of pears, apples, and quinces, is a familiar example. Although we cannot cure or prevent these diseases by spraying, because they work entirely within the plant, we can generally control them by various means which will be considered later.

Fire Blight. — Fire blight is a serious bacterial disease of pears, quinces, and apples. The bacteria work within

the plant tissues, and it is impossible to control the disease by spraying. On account of its prevalence, in certain sections of the country, many of our standard pears cannot be grown. In many of the important pear-growing regions, it annually kills thousands of trees and is probably the most dreaded of all pear diseases. It appears early in the spring at blossoming time and is believed to be carried by bees from tree to tree. The blight attacks the tips of the young growing branches and works its way down to the larger limbs. If not checked, it spreads so rapidly that in a single season, an entire orchard may be ruined by it. It causes the leaves to turn dark brown or black and the infected branches to shrivel and dry.

Although this disease cannot be cured it can generally be controlled. Certain varieties of fruits are more susceptible to fire blight than others. The Russian varieties of apples such as the Wolf River and the Alexander are very susceptible, as well as the Clapp's Favorite and the Bartlett pears, while the Kieffer pear seems to be especially resistant. Hence the necessity for selecting resistant varieties. As the blight infects most readily the vigorous growing branches, infected orchards should be checked in their growth. The trees should be kept in a strong healthy condition, but they should not be allowed to produce soft, sappy, luxuriant growths. All forms of nitrogenous fertilizers should be withheld and if the orchard has been tilled, it should be seeded at once. Care should also be taken not to leave wounded parts of the trunk or branches exposed.

The trees should be watched for the first signs of the disease upon the tips of the branches, especially during the rapid growth of the spring. Infected branches should be

cut away and burned immediately. All tools used should be disinfected in a 5 per cent carbolic acid solution after each cut. In the early spring before the buds swell, the orchard should be pruned carefully, cutting away all diseased wood well below the infected area. Cankers on the larger branches should also be cut out, burned, and the wound disinfected. It is upon these cankers that the blight is often carried over from year to year.

Peach Yellows. — Peach yellows is one of the most dreaded diseases of peach trees. Although it cannot be cured, it may be controlled. The disease first becomes apparent on the infected fruit which ripens prematurely, is very highly colored, often spotted with red, and usually filled with red streaks extending from the pit to the skin. As the disease advances, the leaves turn yellow and in the advanced stage, small, slender reddish shoots bearing narrow yellowish leaves are produced. In the beginning only certain branches seem to be affected, but the disease soon spreads to the whole tree.

The only method of controlling this disease is to watch carefully for any signs of it and to uproot and burn affected trees as soon as the disease is detected, as it spreads very rapidly through the orchard. During the harvesting period, one should be especially watchful and mark all trees that show the least signs of being affected. Immediately after harvest, all such trees should be uprooted and burned.

"**Little Peach.**" — In some regions, "little peach" is as serious a disease as the peach yellows. As the name implies, the fruit fails to enlarge, and the infected tree soon dies.

The treatment for "little peach" is the same as for

peach yellows. There is nothing that can be done with infected trees except to uproot and burn them.

Crown Gall. — Crown gall causes unsightly swellings to appear on the roots of fruit trees. It is most frequently found on young nursery stock. From the enlarged swellings or knots, numerous fine roots are frequently produced, hence this disease is often called "hairy root."

Fig. 151. — Roots infected with crown gall.

The extent of the injury caused by it is not definitely known, but it is probable that the vitality of the tree is seriously weakened. Nursery stock should be examined before planting, and infected stock should be rejected. This is the only preventive practiced by the fruit grower.

EXERCISES

1. Give examples of chewing insects, sucking insects, bacterial diseases, and fungous diseases.

2. Why is an orchard planted in a hollow more susceptible to fungous diseases than one upon high sloping land?

3. How does the method of pruning exercise an influence over disease control?

4. Examine bare twigs and storage apples for San José scale. With a pin lift the scale from the insect and examine each with the lens. What spray is used against this pest and when is it applied?

5. Obtain three perfectly sound apples. Break the skin of one, bruise another without breaking the skin, and leave the

third perfectly sound. Lay away on a plate and observe at intervals, noticing in which apple decay first starts. What does this teach us regarding the way fruit should be handled?

6. How many broods of the codling moth are there in your region? When does each appear?

7. How would you detect and handle a case of fire blight?

HOME PROJECTS

1. Make a collection of samples of all the diseases of the common fruits of your locality, classifying the same as outlined in the text. Describe the life history of each, extent and character of the injury done by each, and the proper methods of control.

2. Spray the home orchard for the control of insects or plant diseases.

3. Visit neighboring orchards and collect specimens of all insects infecting them.

CHAPTER VIII

SPRAYING MIXTURES

SPRAYS FOR FUNGOUS DISEASES

Bordeaux Mixture. — Bordeaux mixture is one of the standard fungicides and is used especially for fungous diseases of the potato, grape, currant, gooseberry, apple, pear, and European plum.

Formula:

Copper sulphate	4 lb.
Lime	4 lb.
Water	50 gal.

This spray proves most efficient when used directly after mixing. To facilitate the work, the fruit grower dissolves the copper sulphate in fairly large quantities, and slakes lime ready for use. In making the mixture, success depends largely upon the way the copper sulphate and lime are united. Each should be diluted as much as necessary before mixing. In making 50 gallons of Bordeaux, the copper sulphate should be diluted to 25 gallons and the lime to 25 gallons before pouring them together. If the mixture is improperly made, it will appear very flocculent and settle rapidly, while a good mixture appears creamy and stands for some time without settling. Only the best fresh stone lime should be used. Prepared or hydrated lime is sometimes used when stone lime is not available.

Strong Copper Sulphate Solution. — Strong copper sulphate solution is sometimes used as a fungicide to apply

upon trees in the spring while they are still dormant. It is often used as an early spray on peaches for the leaf curl, and on apples for the apple scab. The lime-sulphur sprays have largely taken its place.

Formula:

Copper sulphate	1 lb.
Water	25–50 gal.

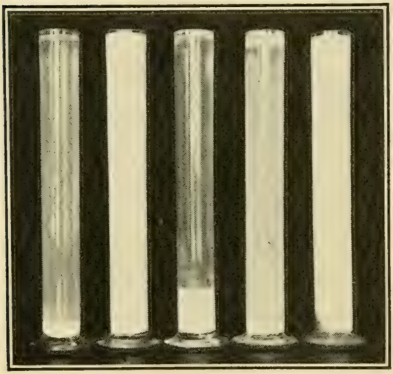

Fig. 152. — Testing samples of Bordeaux mixture by settling. The second and fifth samples are best.

Weak Copper Sulphate Solution. — The weak copper sulphate solution is used as a fungicide to control the rot on stone fruits when the fruit is so far advanced that other sprays would discolor it. As this spray contains no lime, it does not stick so well as Bordeaux mixture and hence must be applied more frequently. For peaches and Japanese plums it should be weaker than for the other fruits.

Formula:

Copper sulphate	1 lb.
Water	150–300 gal.

Self-boiled Lime-sulphur Solution. — This is a fungicide used for trees having very tender foliage and is especially valuable for spraying peaches and Japanese plums.

Formula:

Lump lime	8 lb.
Sulphur	8 lb.
Water	50 gal.

Good stone quicklime is selected and enough water added to almost cover it. The sulphur is sifted and added to the lime as soon as slaking begins. Constant stirring during the slaking process is necessary, and sufficient water to prevent burning should be added. This mixture should slake vigorously for five minutes, when cold water should be added to prevent further cooking.

Dilute Lime-sulphur Solution. — The advantages of this spray over Bordeaux mixture are that it can be prepared very readily, it does not clog the spraying nozzles, or cause burning of the foliage and russeting of the fruit.

Fig. 153. - Spraying cherries to control the rot. A typical fruit sprayer used by fruit growers.

It is used especially during the growing season on the foliage of apples, pears, European plums, and cherries, but it cannot take the place of Bordeaux mixture in the control of potato and grape diseases.

It is prepared by diluting either the commercial or home-made concentrated lime-sulphur solution. The amount of

dilution will depend entirely upon the strength of the concentrated solution and the kind of trees to be sprayed.

SPRAYS FOR CHEWING INSECTS

Arsenate of Lead. — Arsenate of lead is used extensively to-day for chewing insects. It sticks better than

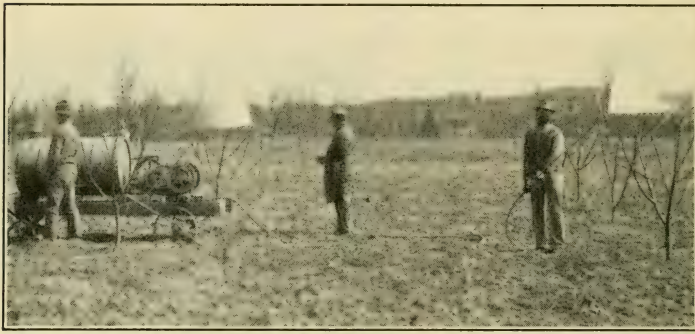

Fig. 154. — Spraying with arsenate of lead, just after petals fall, for codling moth worm.

Paris green and is not so likely to burn the foliage. When the lime and sulphur sprays are used as a fungicide, it is one of the few poisons that can safely be mixed with them.

Formula:

Arsenate of lead	2 lb.
Water	50 gal.

This poison is usually sold in small kegs and comes in the form of a paste resembling white lead. Some companies manufacture it in the powdered form. In such cases but half the amount (by weight) recommended in the formula should be used.[1]

Paris Green. — Paris green may be safely used with Bordeaux mixture, but not with the lime-sulphur sprays.

[1] Arsenate of calcium has given good results as a substitute for arsenate of lead and may be used on all except the stone fruits.

It is always advisable to use lime with Paris green to prevent burning and to help the Paris green to adhere to the foliage. This spray is used on the potato vines to control the potato beetle more than for any other purpose.

Formula:

Paris green	½ lb.
Stone lime	2 lb.
Water	50 gal.

Hellebore. — Hellebore is the powdered root of a plant. It kills insects both by contact and as a poison applied on the foliage. Since it is not so strong a poison as the arsenical compounds, it may be used with greater safety a short time before the fruit ripens. It is used chiefly against the currant worm.

Formula:

Hellebore	1 lb.
Water	25 gal.

SPRAYS FOR SUCKING INSECTS.

Strong Lime-sulphur Solution. — There are various formulas for making the lime-sulphur solution for scale insects, but the following is an old favorite formula that has been used by fruit growers for many years and is still considered very satisfactory.

Formula:

Lump lime	20 lb.
Sulphur	15 lb.
Water	50 gal.

After weighing out the proper amount of stone lime and sifting 15 pounds of sulphur, the lime is poured into the cooking tank which contains 5 or 10 gallons of boiling water, and the sulphur is then added. Enough cold water

should be added to prevent boiling over and to maintain a thick liquid. When the mixture has boiled about an hour, it should be of a dark amber color. It is then diluted to 50 gallons and applied to the trees while still hot.

In making a small quantity of the spray, an iron kettle may be used, but when larger quantities are desired, it is boiled by live steam in a barrel or in a large wooden tank.

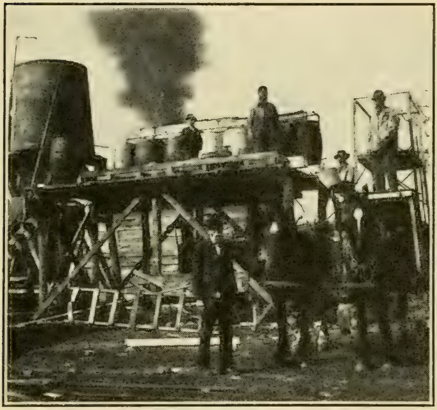

Fig. 155. — Making lime-sulphur spray.

Concentrated Lime-sulphur Solution. — Growers that have the facilities for cooking lime and sulphur frequently prefer to make it in a concentrated form. This may afterwards be diluted in spraying for the San José scale or used as a summer spray for fungous diseases. This spray is cooked in a similar manner and is afterwards strained into an air-tight barrel, as exposure to air causes the sulphur compounds to lose their value. Each lot should be tested with the Baumé hydrometer and diluted when used, according to the dilution table.

Formula:

Stone lime	75 lb.
Sulphur	150 lb.
Water	50 gal.

Tobacco. — There are various tobacco extracts now upon the market used as contact sprays for plant lice and other

insects. The variation in the strength of the several brands is such that the recommendations of the makers as to dilution should be followed. Nicotine sulphate (40 per cent solution) is widely recommended for plant lice. A half pint of nicotine sulphate is mixed with 50 gallons of water, to which 3 pounds of soap dissolved in hot water is added.

Kerosene Emulsion. — Kerosene emulsion is used especially as a summer spray for plant lice.

Formula:

Hard soap	$\frac{1}{2}$ lb.
Kerosene	2 gal.
Water	25–50 gal.

Dissolve the soap in a gallon of soft boiling water and add the kerosene, which should have stood in a warm room to allow it to become as warm as possible without danger from fire. Mix together and stir vigorously for about five minutes or until it becomes creamy white.

For spraying dormant trees dilute only to 15 gallons; for spraying trees in foliage dilute to 25 to 50 gallons.

EXERCISES

1. In Bordeaux mixture the copper sulphate is the active fungicide. Why is the lime added?

2. What classes of orchard pests are controlled by Bordeaux mixture and dilute lime-sulphur solution?

3. What class of poisons must be added for chewing insects? How are they prepared?

4. In the control of sucking insects, what sprays are used most commonly? How are they made?

5. Why is arsenate of lead preferred to Paris green?

6. Why is it best to use lime with Paris green?

7. At what period of growth should hellebore be used as a poison? Why?

HOME PROJECTS

1. Arrange with a local fruit grower for a spraying demonstration. Enter in your notebook a report covering the following items:

(*a*) Name of grower.

(*b*) Kinds of fruit sprayed.

(*c*) Purpose of spraying.

(*d*) Date of spraying.

(*e*) Formula of spray used.

(*f*) Pressure carried during application.

(*g*) Description of engine, pump, capacity of tank, length of hose and poles, kind and number of nozzles, number of trees sprayed per tank.

(*h*) Method of application.

(*i*) Average number of gallons per tree of spray used.

(*j*) Total cost of labor and material per tree.

2. Select eight trees of about equal size in your own orchard. Spray four of them as directed in the foregoing chapter with lime-sulphur solution and arsenate of lead at the proper times. Compare the yield of the sprayed trees with that of the unsprayed trees.

CHAPTER IX

THINNING, HARVESTING, AND STORING FRUIT

Thinning. — Trees often form more fruit than they can properly develop. The breaking of trees while heavily loaded is one result of overproduction. The practice of picking off part of this fruit before it is matured is known as thinning. All scabby, wormy, small, and otherwise inferior specimens are removed and the remaining fruit thinned to such a distance as to allow perfect development of those left on the branches. This concentrates the strength of the tree into the development of the best specimens.

It is the practice of progressive fruit growers to thin peaches, plums, and pears when the trees are heavily loaded. The thinning of apples has not been so generally practiced. However, the grower endeavoring to produce perfect fruit must practice thinning if he wishes to obtain the highest percentage of good-sized specimens. Thinning does not increase the total yield per tree, but it does greatly increase the total of first-class fruit produced.

When fruit is set very thickly upon the tree, there is much danger of severe injury from certain diseases and from insects. With the stone fruits, if the weather happens to be warm and moist during the harvesting season, brown rot often proves a serious trouble. When the fruit is so close that the individuals touch each other, the disease spreads very rapidly, but if the fruit has been thinned, the disease will not prove so serious. In thinning the fruit,

all diseased specimens should be carried from the orchard and destroyed. Thinning also tends to increase the crops in the off years of varieties that bear heavily one year and lightly the succeeding year.

The operation of thinning depends on so many conditions that no definite rule can be given. Most growers have learned by experience the proper distance that fruits should be thinned. As a general rule apples should be allowed to produce but one fruit to the spur and should

Fig. 156. — An overloaded peach tree.

be thinned to a distance of six to ten inches. Large-sized varieties of plums are thinned to three to four inches, the smaller varieties are thinned to a less distance. Damson

plums are allowed to produce heavily as it is not desirable to grow them too large in size. Peaches should be thinned to a distance of three to six inches. The large-sized varieties of pears should be thinned about the same as for apples. Small fruits are not usually thinned.

The earlier in the season the fruit is thinned the better. With most of the tree fruits, thinning should begin immediately after the "June drop." Thinning may be done in August if there is danger of breaking the limbs by overproduction, but the other benefits will not be so pronounced as if the work had been done earlier in the season.

Fruit is usually thinned by hand, although small shears made especially for the purpose are sometimes used. Care should be taken not to injure the fruit spurs in the operation. When fruit is thinned by hand, the spur is grasped firmly in one hand while the fruit is removed with the other by bending it and twisting backward. The cost of thinning is not great, as the actual time consumed in thinning is saved at the harvest time in picking and in sorting the crop. In the Northwest where this practice is very common, it is estimated that thinning costs one and a half to two cents per bushel of harvested fruit.

Picking. — The quality and grade of fruit depend much upon the time and method of picking it. The proper time to pick fruit varies with the kind and the variety. No definite rules can be given, as much depends upon the distance the fruit must be shipped, the climate, season, and other local conditions. When fruit is to be shipped long distances, it must be picked earlier than fruit intended for the local market. All fruits except the pear reach their highest quality when they are allowed to ripen on the trees.

Apples are generally picked when they are well colored

and have reached full size. Summer apples and early fall varieties are sometimes picked before this time. Winter apples are harvested when they are well colored, of full size, and separate readily from the spur.

Pears should be harvested when they are of full size, of good color, but while still firm. As soon as the fruit has reached this stage and separates from the spur by raising it upward, the crop may be picked and left to ripen in a cool, dark place.

Plums are picked when they are fully colored but still firm. In the home orchard, they should be left to ripen on the trees. The Japanese varieties may be harvested before they are ripe, as they will color and ripen after picking. During seasons when the rot is serious the fruit may be gathered slightly earlier, although this disease proves destructive even after the fruit is picked.

Fig. 157. — Picking and packing cherries.

Sweet cherries, when grown for the market, are commonly harvested just before they ripen. In the home orchard they may be left until ready to eat. When the weather is extremely warm and moist, it is better to harvest the fruit before it is perfectly ripe rather than to run the risk of destruction from rot.

Peaches are of finest quality when allowed to become fully ripe upon the tree, but in the commercial orchard they should be picked when they are of full size, of good color, and show the first signs of ripening. Fruit growers test the ripeness of the fruit by pressing it gently with the ball of the thumb. If it feels elastic, it is ready to ship. Early white-flesh varieties are especially subject to rot, and early picking of these is often advisable.

Fig. 158. — Peaches as packed in New Jersey for market.

The success of harvesting depends as much upon the care in picking as upon the time. Any bruise or rupture of the skin which softens the flesh causes the fruit to decay. Carelessness in picking often does not become apparent until the fruit ripens. Fruit should not be thrown, tossed, or handled in a careless manner. It should be carefully picked by hand. Stemmed fruit should be separated from the spur or branch by slightly twisting or bending it upward, being careful to preserve a perfect stem. In picking cherries, grapes, and strawberries the fruit should not be touched, but it should be picked by the stem. Peaches are picked by giving the fruit a slight twist.

The fruit grower should not allow pickers to climb the trees. Peaches, plums, and many of the other trees should be grown to such a form that the larger portion of the crop may be harvested from the ground. When ladders are necessary, they should be constructed of light durable material and made in such a form as to be most easily handled. Long basswood ladders, built in the form of an inverted V, are light and may be pushed easily between the branches. Stepladders built with a one-legged brace stand up better on uneven ground than those with two legs. Some growers prefer a basket or pail as a receptacle, others prefer a canvas sack. There is danger of bruising fruit by dropping it carelessly into the basket, while with the sack, a careless picker rubs the fruit against the ladder. Care should be exercised in emptying these receptacles. The contents should not be poured roughly into the box or barrel, but the fruit should be allowed to roll out gently.

Grading. — For the most successful packing of fruit there is nothing more essential than proper grading. Size, color, and freedom from blemish are all essential in making the grades. Large and medium sized fruit should not be placed in the same package, or highly colored fruit with that which is poorly colored. Although medium-sized fruit sells well when placed in a package by itself, it generally becomes second-grade fruit when placed in a package with larger specimens. Grading, therefore, results in getting better prices for the large fruit and just as good prices for that of medium size as if mixed together.

The market grades of fruits are variously designated. The choicest fruit is marked "choice," "select," or "fancy," and the second-grade stock "first," "A 1," or

Fig. 159. — Packing apples. Most of the apples in the Northern States are sorted and packed in barrels in the orchard and shipped directly to the cities.

simply "A." Some growers call their best stock "3X," their seconds "2X," and their third "X." Others brand their third quality stock as "seconds" or "A" brand.

Packing. — Whatever form of container is used in fruit packing, it should be clean, light, durable, and cheap.

Apples are commonly packed in barrels and although the size of the apple barrel varies in the several states, the general method of packing is the same. The first two tiers placed in the barrel are faced; that is, placed in regular rows with the stems downward. These should be of uniform size and color and typical of the remainder of the fruit in the barrel. Starting on the outside of the barrel, they are placed in concentric rings, and those of the second

tier are placed in the depressions of those of the first tier. The fruit is then carefully placed in the barrel, shaking it frequently to settle it well until the barrel is filled to within a few inches of the top. Then the top is faced with one or two tiers the same as the bottom. The head is placed over the fruit and with a barrel press it is forced down into place. The hoops are driven down and nailed. Liners or cleats are then nailed down against the inside of the staves at right angles to the grain of the head to strengthen it.

Apples packed in boxes must be sorted carefully as to size. The method of packing depends so much upon the form and size of the fruit that it is only by experience that one can tell the style of pack best adapted to the particular fruit at hand.

Storing. — Only good fruit will pay for storage. Second-grade stock seldom keeps well. Wormy, scabby, or carelessly handled fruit decays rapidly. Fruit should be placed in storage as soon as possible after harvesting. The common practice of allowing apples to lie on the ground in the orchard to sweat for a few days after picking spoils their storage value. Small packages, as barrels, crates, or boxes, are best for storing fruit, as they can be cooled off rapidly and will not heat under such conditions.

Fruit may be stored in any building in which the temperature, ventilation, and moisture can be controlled. The nearer the temperature is to freezing, the slower is the ripening process. Most fruit is stored at a temperature of from 33° to 35°. Slight freezing will not necessarily injure fruit if the temperature is raised slowly, but there is no advantage in this practice. Fruits lose their quality if the storage room is not properly ventilated. Good venti-

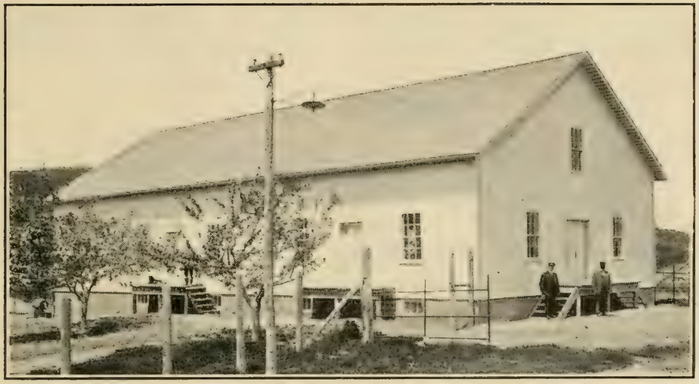

Fig. 160. — Apple storehouse on a Michigan fruit farm.

lation is just as essential as low temperature. A uniform amount of moisture also is important. Fruits decay rapidly in damp air, while if the air is too dry, the fruit becomes withered.

EXERCISES

1. Is thinning practiced in your locality?

2. Will the height of the tree tops have any bearing on the advisability of thinning? In what way?

3. Explain why fruit picked green will keep longer than ripened fruit. Is this fact made use of in the commercial markets? In what way? In what way does cold storage promote the same end?

4. Why is ventilation necessary to stored fruits?

5. What sort of cellar is best fitted for fruit storage? What conditions of your home cellar might be changed to make it conform to the ideal conditions for storage?

6. Visit two or three places in your town where apples are sold, and find out what packages are most used. On how many packages of fruit (grapes, oranges, lemons, bananas, etc.) do you find the label of the packers or shippers?

7. What laws are there governing the packing and labeling of state and interstate shipments of apples? Of other fruit?

HOME PROJECTS

1. Go to a barrel or bin of apples in the cellar and pick out 25 specimens that have started to decay. Note the number of those in which rot seems to have started from a bruise in the skin inflicted in harvesting; of those in which rot seems to have started at the stem where the stem has been pulled out in harvesting; of those in which rot seems to have started in an insect bite or worm hole; and those that show no bruises on the surface. Calculate the percentage of apples rotting from careless handling at harvesting time. What does this teach you regarding the care that should be taken in harvesting apples?

2. Take the four trees that were sprayed as directed in the previous chapter, and carry out the following experiment with them. Thin one to about 3 inches, one to about 4 inches, another to 5 inches, leaving the last without thinning. Note effect on size and quality of fruit.

CHAPTER X

THE POMES — APPLES, PEARS, AND QUINCES

Apples. — The apple is the most important American fruit. The wide variation in the time of maturity of the several varieties and the long storage season of the fruit make the apple available throughout the greater portion of the year. Its easy transportation makes it the most widely known and most widely used of all fruits, while the productiveness and longevity of the trees make the apple a most profitable fruit to grow.

Fig. 161. – An apple tree that has produced twelve barrels of fruit in one year.

Propagation. — It is commonly known that cultivated varieties of apples seldom come true from seed. Seedlings of large red apples may produce small yellow fruit. The fruit grower desires to know definitely the kind of fruit that he is to grow. To perpetuate standard varieties, therefore, it is necessary to resort to some form of grafting. In mild climates apples are usually propagated by budding while in other less favorable sections they are propagated somewhat more successfully by root grafting.

Fig. 162. — An ideal orchard site. The slope to the lake provides good soil and air drainage.

Planting. — Apples are grown upon various types of soils, although a deep, open, well-drained clay loam is considered best. Orchards upon less favorable soils require more careful management. When the soil is of a light, sandy nature the trees come into bearing earlier and the fruit is often more highly colored, but the trees are seldom so long lived.

Apple trees are set in the orchard at from one to three years of age, the younger trees being preferred. The distance of planting varies with the variety and the locality. Apple trees are usually planted from thirty to forty feet

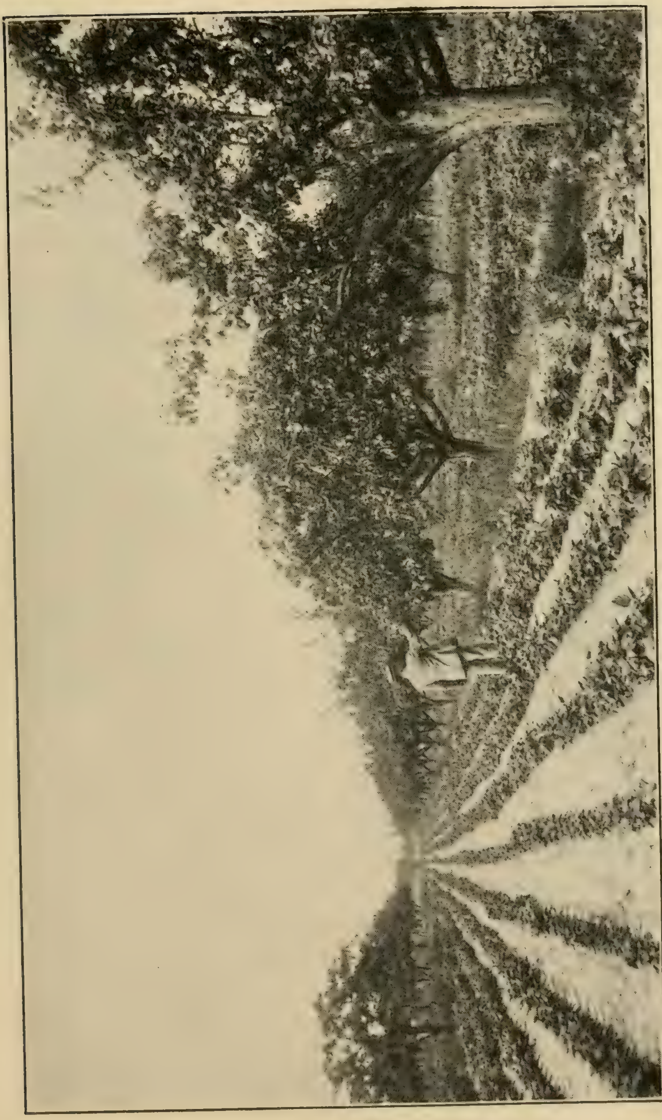

Fig. 163. — Beans growing between rows of apple trees.

apart. The large-growing varieties, like the Baldwin and Greening, require the greater distance. The necessity for plenty of sunlight and air, for thorough cultivation, and for spraying makes wider plantings advisable.

The planting is usually done in the spring, especially where winters are severe. In some sections fall planting is preferred. When the trees are set in the fall on well prepared and thoroughly drained land, they become established before winter sets in, and start to grow in the spring as soon as weather conditions are favorable. This enables them to produce a strong growth before the hot, dry summer overtakes them.

The soil should be plowed, cultivated, and prepared as thoroughly as for corn. If trees are set in sod land a hole five feet in diameter should be dug for each tree. No grass should be allowed to grow in this space and it should be kept cultivated or mulched with straw. On well-cultivated land, the holes are dug large enough only to accommodate the roots; and the trees are set as directed in an earlier chapter. It is better to err in getting the trees a little too deep than not deep enough.

Varieties. — There is no "best variety" for all sections. It is a safe plan to select the standard varieties that are best adapted to each particular section. The principal varieties grown in the apple-growing regions of America include the Baldwin, Northern Spy, Greening, Winesap, Jonathan, McIntosh, Grimes Golden, Oldenburg, King, Wealthy, Wagner, Ben Davis, Gano, Spitzenburg, and Tolman Sweet.

Cultivation. — Cultivation should begin as soon as the trees are planted. It is a common practice to grow corn, potatoes, beans, or some other cultivated crop in the

orchard during the first few years. Grain crops, as oats, wheat, or rye, should never be grown except as cover crops; and after the trees come into bearing intercropping should not be practiced as all the moisture and food of the soil is required for the best development of the fruit.

Pears. — Pears thrive in the Northeastern States and along the Pacific slope. They succeed best in localities characterized by moderate winter seasons and rather cool, moist summers. They grow well on a variety of soils, but prefer a rather stiff clay loam.

Propagation and Planting. — Pears are propagated in much the same manner as apples. They are usually planted at two years of age, although some growers prefer one-year-old trees. The land should be prepared the same as for apples and the trees planted in early spring. The trees are spaced from sixteen to twenty feet apart each way, depending upon variety, locality, and general form to be produced. Pears come into bearing earlier than apples and produce paying crops in a much shorter period. Although pears thrive best with thorough tillage, there is much danger of serious injury from blight when too vigorous a growth is produced. The most careful growers fertilize sparingly and till judiciously.

Pruning. — Pears generally require more pruning than apples. Most of the varieties have a tendency to produce all their growth in the upper central shoots and hence the first few years the pruning should consist in shortening all of these upper shoots. Pears are very subject to sun scald, and therefore the tops should be started very low, usually not more than two feet from the ground, and should receive annual, but moderate pruning. Heavy

pruning not only invites sun scald, but tends to induce too strong and rank a growth. After the top of the pear tree is formed, it is customary to do little pruning except to keep the top free and open. As pears are borne on spurs much like the apple, it is important in pruning that these spurs are not removed unless it is desired to thin the fruit.

Varieties. — Many pears produce infertile blossoms, that is, they need the pollen of other varieties to cause them to set fruit. In planting a pear orchard, it is, therefore, customary to plant not more than four consecutive rows of one variety and to alternate with one or more rows of another variety that blossoms at the same time and produces an abundant supply of pollen. Some of the more important commercial varieties of pears are the Bartlett, Flemish Beauty, Clapp, Anjou, Bosc, Kieffer, Sheldon, Seckel, and Le Conte. Of these varieties, the Bartlett is the leading market pear, while the Kieffer being less susceptible to blight than most others, is used principally as a canning pear.

Quinces. — The quince is a fruit of comparatively little commercial importance. The fruit is used largely for preserving, for marmalades, for jellies, and for flavoring sauces made from other fruits. Its culture has reached its highest development in the Northeastern States and on the Pacific coast.

Enemies of the Pomes. — The principal insects that injure the pome fruits are the codling moth, San José scale, apple maggot, and apple curculio. Those that injure the foliage are the tent caterpillar, cankerworm, webworm, plant lice, and leaf rollers. Those injuring the trunk and branches are the San José scale and apple tree borers.

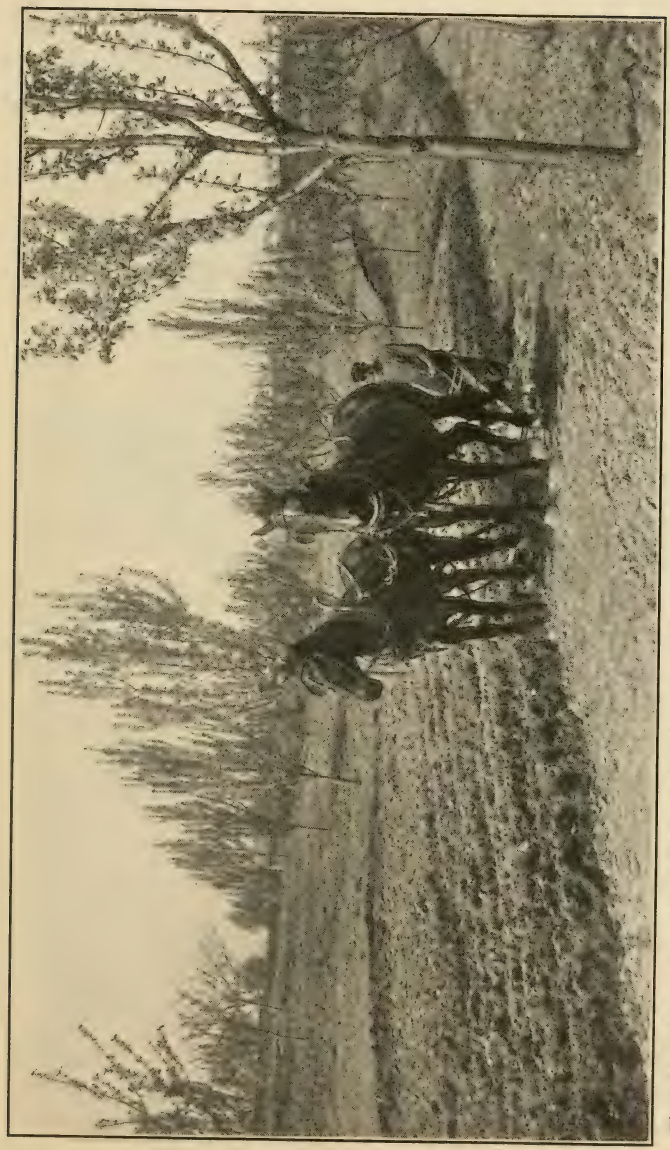

Fig. 164. — A young orchard of Kieffer pears in blossom. The ground is being plowed and will be cultivated until midsummer, when a cover crop will be sown.

Among the common diseases of the pomes, the apple scab, bitter rot, brown rot, and pink rot affect the fruit, while the apple scab and fire blight injure the foliage and young twigs. There are also various forms of cankers that injure the branches. The most serious disease of the pear is the fire blight.

Spraying. — Although the insects and diseases of the apple and pear vary with the locality they can be controlled by spraying as outlined in the chapter on Fruit Pests.

EXERCISES

1. Why are younger trees better for transplanting than older ones? What is the function of the root hairs? In what way is this related to transplanting?

2. Name the best summer, fall, and winter varieties of apples growing in your section.

3. Obtain specimens of five different varieties of apples grown in your locality. If possible get three apples of each variety and make observations of the points indicated below.

Variety	Number of Specimens	Color	Form	Average Circumference	Quality	Value

4. Obtain a branch from an apple tree and draw to natural size. Label the annual rings, fruit spur, fruit scar, fruit bud, leaf bud, and leaf scar. Show with a dotted line where the twig should be cut to form a scion.

5. Obtain three or four plates of apples of five specimens each, and score according to the following score card.

SCORE CARD

Form	
Characteristic of variety	5
Uniformity in form	10
Size	
Good for variety	10
Uniformity in size	15
Color	
Good for variety	10
Uniformity in color	20
Freedom from blemish, worm holes, scab, San José scale, mechanical bruises, broken stem	30
Total	100

HOME PROJECT

Make an orchard survey of the varieties of apples grown in your section, by visiting at least six bearing orchards. Tabulate observations as directed by teacher. Judging from the results of this survey, what do you conclude are the best varieties for your section?

CHAPTER XI

STONE FRUITS — PEACHES, PLUMS, AND CHERRIES

Peaches. — The production of peaches is attended with greater risk than that of most other fruits. The peach is tender in bud and therefore very susceptible to severe freezing during the winter and to late freezes following a prolonged warm spell in the early spring. Late frosts while the trees are in blossom ruin many crops. In the Northern States the peach-growing areas lie near large bodies of water where the temperature is considerably moderated by the water.

It is important to select sites that have good soil drainage and air drainage. On high ridges, ideal sites are found. Usually a sandy loam soil is desired, although excellent crops are also produced upon clay soils. A clover sod that has been previously manured and plowed under is good for a peach orchard. The trees should be planted early in the spring rather than in the fall, as there is danger of winter injury to fall plantings. The trees are set from twenty to twenty-five feet apart and even at this distance heading in and shortening the branches is frequently necessary, after the trees come into bearing, to permit space for spraying, cultivation, and maintaining the orchard.

Planting. — The following general rules should be observed in planting peach trees:

1. Preserve as many of the fibrous roots as possible.

2. Expose the roots as little as possible to the drying influences of the sun and wind.

3. Prepare the roots for planting by cutting away the bruised and broken portions.

4. Plant an inch or two deeper than the tree stood in the nursery. If the soil is very sandy, the tree may be planted three or four inches deeper.

5. Dig the hole in which the tree is to be planted deep enough to receive two or three inches of fine soil before putting the tree in place, and make it large enough to allow the roots to spread in their natural position without crowding.

6. See that good friable surface soil is well packed beneath and over the roots.

Pruning. — After planting, peaches should be pruned to reëstablish the natural balance between the top and root system and to form a well-shaped tree. The spur and the

Fig. 165. — Peach trees with high tops; result of setting trees too close together.

Fig. 166. — A fine example of a low-headed peach tree.

stub systems are the two principal methods of pruning peach trees. If the lateral branches are well distributed along the trunk at the desired height, the spur system is used. Otherwise the tree is pruned to a stub and a new top formed.

Pruning is practiced annually thereafter by removing all the weaker shoots, pruning out the central branches to maintain an open center, and frequently cutting back from a third to a half of the growth of the remaining branches. The degree of heading back depends largely upon the variety, vigor, and productiveness of the tree.

Cultivation. — Peaches need even more thorough and regular cultivation than apples. After the trees come into bearing, they require abundant fertilizers. Cover cropping with leguminous plants is advantageous, as it causes the tree to mature its wood for the winter and supplies organic matter to the soil.

Peaches have a tendency to produce excessive crops. These crops, if allowed to mature on the tree, frequently break the branches and seldom produce individual fruits of sufficient size to satisfy a first-class market. Pruning is

frequently practiced as a thinning process, but in addition to this, hand thinning is often necessary.

Varieties. — The Elberta is the standard market variety in most of the Northern States. Its productiveness, hardiness, and general characteristics make it a most profitable commercial variety. St. Johns, New Prolific, Triumph, Engle's Mammoth, Alexander, Greensborough, Gold Drop, Smock, and Lemon Free are other important varieties.

Plums. — Plums are an important commercial fruit, especially in localities where the climate is too rigorous for peach production. Large quantities of plums are canned, and in many sections the fruit of one class is dried for prunes. In seasons when the peach crop is short, the demand for plums is correspondingly increased.

Varieties. — There are probably more species of plums grown in this country than of any other fruit. The European plum is best known in the Eastern States, although

Fig. 167. — A plum orchard on an ideal site. The well-cultivated ground slopes off to the lake.

the Japanese plums are also widely grown. In sections of the country where the conditions are too severe for either the Japanese or European species, the American or wild plum proves very valuable. The Wild Goose plum is also an important species, especially adapted to southern Iowa, Missouri, southern Illinois, and adjacent sections. The Chicasaw plums are native of the Southern States and grow wild from Delaware south and west to Kansas and Texas.

Soil and Cultural Conditions. — The plum demands a heavier soil than the peach; usually a moderately heavy clay loam is most desirable. On lighter soils, the trees are very subject to injury from prolonged dry spells during the summer. Under such conditions the fruit is small and the trees short-lived. Trees from one to three years of age are selected for planting, many planters preferring a one-year-old tree, as at that age they are cheaper, easier to plant, and produce better formed trees. They may be set from sixteen to twenty-five feet apart, depending much upon the soil and variety. As many of the varieties are generally self-sterile, especially in certain locations, it is important to interplant them with strong, pollenizing varieties that blossom at the same time. Even self-fertilizing varieties seem to produce better crops when cross-pollinated.

With certain varieties of plums, thinning is very important. It is one method of controlling the fruit rot and of producing profitable crops. Damsons and other small plums are not thinned, but the larger varieties often must be thinned to produce large, highly colored fruit. The orchard should be cultivated and cover-cropped as with the apple and peach. Although the plum will thrive better in sod land than the peach, better crops will be produced

and less injury from fungous diseases will result if the orchard is kept in a clean, cultivated condition.

Cherries. — The commercial production of cherries is more restricted than that of most other fruits. This is especially true of the sweet cherries, there being but few sections east of the Rocky Mountains where the soil and climatic conditions are favorable. The production of sour cherries has become one of the leading industries in the humid regions of the Middle West.

Fig. 168. — A well-formed Windsor cherry tree.

Soil and Cultural Methods. — Sweet cherries thrive best on an elevated, light, dry, loamy soil, while the sour kinds will endure more moist climatic conditions and a heavier soil.

Spring planting of trees is usually practiced. The sweet varieties are set thirty to forty feet apart each way, while the sour kinds are set from sixteen to twenty feet. In pruning, three to five main branches about three feet from the ground are allowed to remain to form the framework of the tree. As the sweet cherries have a very upright habit of growth, it is important to prune the lateral branches back to outside buds for a few years to induce a spreading rather than an upright form. The framework branches of the sour cherry are formed like those of the peach tree. Cherries are very subject to gummosis, a disease which is

characterized by the formation of large bunches of gum on the bark. Trees that are formed with the main branches opposite or near together on the trunk are especially subject to this disease.

Cherry orchards are plowed shallow in the early spring and cultivated every ten days or after every rain until midsummer, when they are seeded to cover crops. With sweet cherries, there is danger of overfeeding, as the tree naturally produces a very rank growth. Hence it is often better to grow a cover crop of non-leguminous plants and to withhold nitrogenous manures.

Fig. 169. — A steep slope utilized as a cherry orchard. Note the furrows to prevent soil wash.

Harvesting. — Cherries should be hand picked a few days before ripening. Special shears are sometimes used for cutting the stems, the fruit being allowed to drop on sheets which have been previously spread under the tree. With the finer varieties more care should be exercised. All small and imperfect fruits should be sorted out and the cherries faced and packed into small attractive boxes or baskets. Small cartons holding a pound or more of fruit are often used in preparing fancy packages for special markets. Care should be exercised against breaking the fruit spurs, as a careless picker may, in this way, do much injury to the next year's crop.

Insects and Diseases. — The stone fruits are very susceptible to injury from insects and diseases. The peach

tree borer, San José scale, plum curculio, aphis, and tent caterpillar are the most common insects, while peach yellows, "little peach," brown rot, leaf curl, black knot, peach scab, and shot-hole fungus are the most important diseases of these fruits.

In controlling these insects and diseases, the trees should be sprayed as directed in a previous chapter. Early in the spring the trees should be carefully inspected and all black knots should be cut out several inches below the knots.

EXERCISES

1. To what class of fruits does the peach belong?
2. Can peaches be profitably grown in your section? Why?
3. How long does it take a peach tree to come into bearing after planting?
4. If peaches are grown in your section, name some of the best varieties.
5. Obtain two or three quarts of peach pits and arrange in a box in alternate layers of pits and clean sand so as to show how they are stratified in actual practice. Remove the pits and save them for further work.
6. Get twigs of two different varieties of plums, preferably two varieties growing in your neighborhood. Take from the twigs one flower bud and one leaf bud. Pick them to pieces. By close examination determine how to distinguish a flower bud from a leaf bud.
7. Obtain, if possible, specimens of the plum curculio. Note the six humps on the back, four real humps and two semi-humps. Note also the snout of this beetle.
8. Examine plums or apples for puncture of the plum curculio. Note the dot and the crescent around it.
9. If there are cherry orchards in your home locality, describe the methods of orchard management.

HOME PROJECTS

1. Visit four commercial peach orchards and note in each:

(*a*) The number of trees of each variety in each orchard.

(*b*) Age and condition of each orchard.

(*c*) System of culture.

(*d*) Method of pruning.

(*e*) Materials and times of spraying.

(*f*) Number of trees infected with borers.

(*g*) Number showing signs of peach yellows, "little peach," leaf curl, or other diseases.

(*h*) Number in which the fruit is hand thinned.

(*i*) Cover crop used.

2. With four bearing plum trees of the same variety, age, and general conditions, test the value of pruning, thinning, and spraying.

CHAPTER XII

GRAPES, STRAWBERRIES, AND BUSH FRUITS

Grapes. — Although grapes may be grown on favored sites in many parts of the United States, there are only a few sections of the country where their production has developed into a leading industry. The Northeastern States and the Pacific States are the two most important grape-growing sections. Most of the leading commercial varieties of the Northeastern States are of the native species. West of the Rocky Mountains varieties of the European species are chiefly grown.

Propagation. — The grape is generally propagated from either hardwood cuttings or layers. In California, European varieties are often grafted upon American roots. One-year or two-year-old plants from cuttings are used for setting the vineyard. Where only a few plants are desired, layering is the simplest and easiest method of producing new plants.

Soil and Cultural Methods. — Grapes demand a long season for the development of the crop. The vines blossom early in the spring and the fruit ripens comparatively late in the fall. Hence, it is desirable to select a piece of land for the vineyard that has sufficient slope to provide good air and soil drainage and that is subject to neither late frosts nor early freezes. For these reasons, a sloping site exposed to the south and east is preferred. In sections bordering large bodies of water that exercise a moderating influence

upon the climate, exposure is not so important. For grapes, the ideal soil is a sandy loam with an open clay subsoil, but they may be grown upon any soil of moderate fertility and fair texture having good drainage. On soil that is too rich in nitrogen, the fruit is likely to be of poor flavor and the vines unproductive.

Grapes are planted in the spring in rows about ten feet apart and the vines eight to ten feet apart in the row, depending much upon the vigor of the variety. The land, after being plowed and cultivated, is furrowed out one way and marked the other, the intersection showing the position of each plant. This greatly facilitates the planting. The roots of the plants may be cut back to twelve inches in length and the tops pruned back to two or three buds. As soon as the vines are planted, the vineyard should be cultivated and some hoed crop grown for the first few years. After this time, the plants will require the entire space and the vineyard should be regularly cultivated and cover cropped.

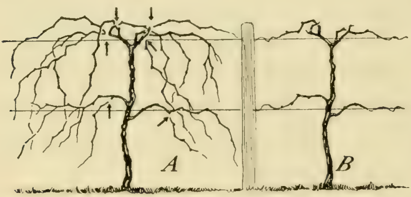

Fig. 170. — A pruned grape vine (*A*), and an unpruned vine (*B*).

Pruning. — Pruning is performed to get the most high-grade fruit from the least amount of vine and to maintain the plant so that profitable crops may be produced for many years. It must be remembered that the old wood that has once borne fruit never bears again, and that if all the new wood produced on the vines is left, it will bear a great many more clusters than it can properly develop. Pruning is practiced as a thinning process, thus concen-

Fig. 171. — A California vineyard. Note the trays on which the grapes are placed as they are gathered.

trating the energy of the plant into a few well-developed clusters. The fruit of the grape is borne upon canes of the present season's growth, which are produced from buds on canes of the past season's growth. The spur system, which simply consists in the pruning back of each cane of the past season's growth to one or two buds, is the simplest system and probably the most common method of pruning.

The renewal system is generally practiced by the commercial growers of our native species. Four of the past year's canes are retained. Each of these is pruned part way back, leaving from six to ten buds on each. Two of these are trained upon the upper wire about five feet from the ground and two upon the lower about three feet from the ground. The buds upon these canes produce the new shoots that bear the fruit.

The grape should be pruned either during the late winter or very early spring, as injury may be caused by pruning in late spring after the sap has begun to flow. Sometimes summer pruning is practiced, which consists in cutting back some of the most vigorous canes, rubbing off all suckers that have started from the base of the roots, and pinching off the side shoots of the canes that are to be reserved for the following year.

Insects and Diseases. — The black rot is the most serious fungous disease of the grape, although the downy mildew and the powdery mildew are also often injurious. The grape cane borer, the flea beetle, the rose chafer, the grape berry moth, the leaf hopper, and the phylloxera, or root louse, are destructive insects of this fruit.

The grape rot appears as brown, circular, decayed spots on the berries, which soon spread over the entire fruit. Infected berries soon shrivel and turn black. The downy

mildew is a fungous disease causing brownish white patches on the under surface of the leaves. It sometimes attacks the fruit as does the black rot, but the infected fruit turns red rather than black. Delaware and other hybrid varieties are most susceptible to the mildew. The powdery mildew is most common in hot, dry weather, covering the surfaces of the leaves or fruit and giving them a gray or powdery appearance.

The phylloxera, or root louse, is not a serious insect on the American varieties, but upon the European varieties it is one of the most dreaded and destructive of all insects. Grafting these varieties on our native stocks is the best preventive. Sometimes the grape cane borer proves very destructive, attacking the young shoots in the spring and causing them to droop suddenly or break off entirely. To control this insect, all diseased wood and prunings should be promptly burned. Injured shoots should also be cut off and burned at once. The rose chafer and leaf hopper are the most difficult insects to control upon the grape. Spraying with tobacco extracts is probably the most efficacious remedy. Clean cultivation and the destruction of all leaves, grass, and other débris in the neighborhood that might make a harboring place over winter for these insects will help to prevent them. The leaf hopper feeds early in the season upon the strawberry and bush fruits, hence these fruits should be grown some distance from the vineyard.

Spraying. — If fruit free from rot, mildew, and other fungous diseases is desired, spraying must be practiced regularly. When the shoots are from eight to ten inches long the vines should be sprayed with Bordeaux mixture to prevent the black rot and downy mildew. The vines should be sprayed again, just before the blossoms open, with

the same mixture, to which two pounds of arsenate of lead has been added to poison the grape berry moth. The third spraying should be applied just as the blossoms are falling, and another about two weeks later. It may be necessary to make another spraying later with the same mixture. If it becomes necessary to spray after this time to control the rot, weak copper sulphate should be used in preference to the Bordeaux mixture, as the latter will stain the fruit.

Strawberries. — The strawberry is one of the most popular of American fruits and hence the supply is seldom equal to the demand. Strawberries are propagated by the separation of runners produced by the plants. New varieties are produced from seedlings, but it is seldom that new seedlings prove of superior value to the standard varieties. Most varieties produce an abundance of runners which are attached to the old plant the first season. These are the plants that should be selected for setting a new patch. Old plants are not desirable.

Soil and Cultural Methods. — Strawberries may be grown successfully on almost any soil. A sandy loam soil is preferred, but good crops are produced upon any soil that is good enough for corn. For early fruit, a southern slope is best, but a northern slope is most desirable, as this plant requires cool, moist conditions for its best development. For this reason, also, strawberries should be planted very early in the spring, so that the cool, moist weather may encourage a strong development of the plant before the warm, dry period of midsummer overtakes them. Sod land should be avoided, as the white grubs, so destructive to strawberry plants, are most prevalent there. The plants are usually dug just before setting and the older and dis-

eased leaves removed. It is important, in transplanting, to shield the roots from the sun and wind, hence they are usually carried in a pail of water or in a basket covered with moist cloth.

If the strawberry plant is set too deep, the soil washes over the crown and kills it, while if set too shallow, the soil will soon settle away from the roots, leaving many of them exposed to the sun. If the soil is light and sandy, there is

Fig. 172. — Strawberries planted between the rows in a young orchard.

less danger in planting too deep, but even under these conditions it is better to set the plant in such a manner that the crown will be level with the top of the soil after it has settled.

There are several systems of training strawberries. The system used will depend much upon the variety and demands of the market. The matted-row system is the most common. Here the plants are set about eighteen inches apart in the rows with the rows three to four feet apart. The new runners are allowed to set wherever they

will, with the result that at the end of the first season, nearly all the space between the rows is covered with plants.

Fig. 173. — An excellent stand of strawberry plants on the matted-row system.

Under this system the production is usually the heaviest, and less care is demanded in training and caring for the plants.

The hedge system is often most desirable where a special market is at hand and good prices may be obtained for first-class berries. The fruit is usually larger and more uniform in size although not so many quarts are produced per acre. Greater care is also necessary in training the plants. In starting this system the plants are set in rows about two and a half feet apart and the plants eighteen inches apart in the rows. Each plant is then allowed to produce two runners, one each way of the row. All other runners are cut away. Sometimes a double-hedge system is used, which increases the production per acre. Here two such rows are planted six to ten inches apart and with a space of two and a half feet between each double row.

Sometimes strawberries are grown on the hill system. The plants are set eighteen inches to two feet apart each way and no runners are allowed to set about the plants. They may then be cultivated each way, and strong, vigorous crowns will be produced. Under this system, the largest and finest berries may be produced, but the production is so much smaller on any given area that it seldom proves a desirable commercial system.

Cultivation. — The strawberry is a very shallow-rooted plant, and since it thrives under cool, moist conditions, frequent shallow cultivations are required. When the plants are set on the matted-row system, it is advisable to cultivate each row always in the same direction. If not, the runners will be disturbed by the cultivator. Cultivation must be continued until late fall, as the growth is very rapid and runners are produced very heavily during the late summer and fall. It is quite necessary that the patch be absolutely free from weeds when freezing weather finally stops the growth.

Strawberries are generally mulched, in late fall or early winter after the ground has frozen, with clean straw free from weed seeds, or with marsh hay. This prevents the alternate freezing and thawing during late winter and early spring which tears the roots and kills the plants. This mulch is left on the patch until after the harvesting season, thus taking the place of cultivation the following spring. Generally, it is the practice of the growers to remove the straw slightly from the tops of the plants as soon as the growth begins in the spring. During the harvesting period, the straw about the base of the plants keeps the fruit clean and free from grit.

Where strawberries are grown on a commercial scale,

the patch is plowed under immediately after harvesting and a new plantation is set out each spring. Sometimes a patch is allowed to bear for two seasons, but the production is not so heavy the second year.

In fertilizing a strawberry patch, it is a practice to manure the field heavily the year before setting, growing some hoed crop. If additional fertilizing is necessary, commercial fertilizers are used at the time of planting. The following spring, shortly after the growth starts, nitrate of soda is applied at the rate of about 150 pounds per acre. This should be broadcasted while the foliage is dry to prevent burning. An ideal time to apply it is just before a rain. If the plants need a stimulus later in the season just before fruiting, a similar application should be given.

Varieties. — In selecting varieties of strawberries, it is necessary to remember that some varieties are pistillate; that is, they have no well-developed stamens and so are unable to pollenize themselves. These varieties, if planted alone, will seldom be fruitful. Pistillate varieties are often called imperfect varieties, while those varieties having strong stamens are called perfect or staminate varieties. In setting strawberries, it is the practice to set at least one row of a perfect sort to two rows of an imperfect sort. It is necessary, of course, that the two varieties blossom at the same time, so that the pollen of a perfect sort may be available when the imperfect varieties are in blossom. Perfect-flowering varieties, of course, may be planted alone.

Insects and Diseases. — Strawberries are seldom troubled seriously by insects and diseases. By care in the selection of varieties, by rotation, and by good culture serious injury may be avoided. Leaf spot and mildew are the two

chief fungous diseases, while the white grub, leaf roller, and strawberry root louse are the principal injurious insects.

Bush Fruits. — The bush fruits include the currants, gooseberries, blackberries, raspberries, and dewberries. They are more easily grown than most of the tree fruits and give greater yields and quicker returns. As the de-

Fig. 174. — Spraying strawberries.

mand for fresh bush fruits in the local markets is usually greater than the supply, they are profitable crops for the fruit grower.

Soil and Cultural Methods for Currants and Gooseberries. — The ideal soil for currants and gooseberries is a rich, moist, rather heavy soil, although in the Northern States good yields are grown on lighter soils. There are probably no cultivated crops that respond more generously to manuring than these fruits. Much humus in the soil furnishes the richness, coolness, and moisture that they require.

Except in localities where the winters are very severe, fall planting is generally preferred. The plants then take hold early in the spring and become well established before the hot weather. If planted in the spring, they should be set out as early as possible.

Currants and gooseberries are generally propagated by hardwood cuttings taken in late fall or early winter. One-year and two-year-old plants are used for setting. Sometimes they are propagated by mound layering, but they root so readily from cuttings that layering is seldom practiced.

Fig. 175. — Harvesting currants. Note crate and boxes used for shipping.

Currants are usually set four to six feet apart in the row with the rows from four to eight feet apart. Black currants, being larger plants, require more space than red or white currants or gooseberries. As these plants are all shallow rooted, shallow cultivation should be given. It is necessary to cultivate regularly to preserve soil moisture.

Pruning. — After the plants are set, little pruning is required during the first three seasons, except to thin out weak and crowding shoots and to head back over-vigorous

ones. After this time, pruning should consist in cutting away a few of the oldest canes at the base each year, leaving a few of the vigorous young shoots from the roots to

Fig. 176. — A well-kept gooseberry patch.

take their places. The largest bunches of currants are grown at the base of one-year-old lateral shoots or on one-year-old spurs. Therefore, to get the highest quality of fruit, it is necessary to keep up a continuous supply of these vigorous shoots. The common mistake in pruning currants and gooseberries is to let the bushes remain too thick.

Fertilizers. — Well-decomposed stable manure is the most popular fertilizer for these fruits. This may be spread around the bushes in the fall and worked into the soil in the spring. Unleached hardwood ashes are valuable, especially upon the stronger soils on which heavy applications of manure would tend to produce too much wood.

Harvesting. — Gooseberries and currants have a long harvesting season. The fruit may remain on the bushes

for several days without injury. Currants are usually picked by pinching off the bunches, keeping the berries perfect on the stems. Gooseberries are harvested by stripping the branches and afterwards running the fruit through a fanning machine to remove the leaves.

Insects and Diseases. — The gooseberry mildew and leaf spot are two common fungous diseases, while the currant worm, the currant borer, and the San José scale are the most injurious insects.

The gooseberry mildew is especially troublesome upon the English varieties of gooseberries and is more prevalent in sections having a hot, dry climate. It appears as a cobweblike growth on the young foliage, killing or checking its growth. The leaf spot appears as small brown spots that cause the leaves to turn yellow and drop. The bushes are often defoliated in midsummer by this disease, which seriously weakens the plant and prevents the formation of well-developed fruit buds for the following season.

The small green worms found on the under side of the leaves of the currants are hatched from eggs laid by a small fly about the size of a house fly. The worms are first white, later becoming green with black spots, and finally becoming green tinged with yellow. They eat the leaves, often defoliating the bush in two or three days. The currant borer is hatched from eggs laid near the tip of a shoot by a small moth. The worms burrow down the center of the shoot and give it a sickly appearance.

Treatment. — Currants should be sprayed, early in the spring before the buds open, with strong lime-sulphur solution for the San José scale. Just as the leaves are expanding they should be sprayed with Bordeaux mixture or dilute lime-sulphur solution, to which has been added 2

pounds of arsenate of lead to every 50 gallons. This spray should be repeated when the fruit is about one fourth grown. If the currant worms are troublesome after this time, the foliage should be dusted with pyrethrum.

If the foliage becomes suddenly wilted at any time, it indicates the presence of the cane borer. Cut out the affected shoots and burn.

Brambles. — The brambles include the red raspberries, black raspberries, blackberries, and dewberries.

Propagation. — Red raspberries produce numerous shoots from the roots, which are generally used for starting a new plantation. It is often customary, however, when there is a shortage of plants, to propagate them by root cuttings. The black raspberries (black caps) are usually propagated by tip layering. The high-bush blackberry is propagated by suckers and root cuttings, while the dewberries may be multiplied by layering the new canes, which root readily in midsummer.

Soil and Cultural Methods. — The brambles prefer moist, cool growing conditions. It will be noticed that the brambles grow best in the wild, near the edge of woods or about decaying stumps, hence a northern exposure and a soil that contains plenty of humus and plant food is generally preferred. Brambles will grow on poorly drained soil, while on light soils, if properly handled, good crops may be produced. They are generally set in rows six to eight feet apart, with the plants from three to six feet apart in the rows.

During the first season, frequent cultivation is necessary, unless mulching with straw or hay is practiced. Soil tillage is generally most practical as a means of preserving soil moisture, which is so essential to a vigorous growth

of the brambles. Tillage should cease about the first of August to ripen up the canes. At that time, a cover crop of rye, vetch, oats, or some other suitable crop may be sown.

Fig. 177. — A sturdy row of blackberries in bloom.

Pruning. — When the new canes are about two and a half to three feet high, the ends should be pinched off to induce branching. If these canes are allowed to grow, they become unmanageable and produce few lateral branches. Usually larger crops are produced from the branched canes, although in some localities black raspberries and blackberries seem to produce more when they are not topped during the summer. Directly after harvesting, all of the old canes that have borne fruit should be cut close to the ground. This concentrates the energy of the plants into the new canes which are to produce the crop the following season. Early in the spring, the plants should be pruned again and all small,

weak canes should be cut out completely, leaving as many well-developed canes as the plant can properly maintain. The lateral branches should be cut back to strong, mature buds, the distance varying much with the variety and maturity of the wood. This pruning thins the fruit, thus permitting better development.

Brambles usually bear a small crop the second year after planting and a full crop after that time.

Varieties. — The blackberries and purple-cane raspberries usually produce the heaviest crops. The purple-cane raspberries are hybrids between the native red and the native black raspberry, and are especially desirable for canning. Their fruit is soft and of a rather dull color and hence not popular as a general market sort. When canned, however, the fruit assumes a very attractive color. The most popular varieties of the purple-cane raspberries are Shaffer and Columbian. Of the blackberries, the Snyder is one of the most cosmopolitan varieties although of comparatively poor quality. The Early Wilson, Agawam, Eldorado, and Taylor are other important varieties, while of the black raspberries, the Plumb Farmer, Gregg, Cumberland, Kansas, and Ohio are the most popular. Cuthbert is the standard red raspberry and the Marlboro is also an important red variety.

Dewberries are seldom an important commercial fruit. They ripen earlier than the blackberry. Although seldom a very profitable crop, they are grown to obtain the early market. They are cultivated the same as the blackberry, but the vines are trained either to a wire trellis or to a stake. The fruiting canes should be tied up each spring and the new canes allowed to sprawl over the ground. The Lucretia and Bartel are the most important varieties.

EXERCISES

1. How are grapes generally propagated? How are they propagated in your section? Give the climate and seasonal requirements of grapes. Is your summer long enough for them to mature? How many days in your summer season? What slope is preferred and why?

2. At what distance apart are grapes planted? How many plants can be set on an acre if the plants are set 8 feet by 10 feet? At six cents a plant what would it cost to set out an acre of grapes?

3. What injury is likely to result from late spring pruning of grapes?

4. When and what spray should be applied to grapes? What diseases does it control?

5. Obtain three or more bunches of grapes and score the same, using the following score card.

Score Card for Grapes

Form of bunch	15
Size of bunch	20
Size of berry	20
Color	10
Flavor	15
Freedom from blemish	20
Total	100

HOME PROJECT

Select 100 young strawberry plants of two standard varieties. Plant half of each on the matted-row system and half on the double-hedgerow system. Cultivate, weed, and mulch, as directed in the text. Keep a record of the labor expended upon each and write a detailed description of each operation.

CHAPTER XIII

VEGETABLE GARDENING

VEGETABLE gardening may be grouped conveniently under the following divisions: home gardening, market gardening, truck gardening, and vegetable forcing.

Home Gardening. — On every farm the vegetable garden occupies a position of importance as a source of food sup-

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Fig. 178. — A typical school garden.

ply, while in the suburbs of the larger cities, as well as upon the home lot of the village dweller, its products are of even greater importance in supplying the home table. Millions of dollars' worth of vegetables are annually produced by such gardeners, and their products constitute an important source of our food supply.

Fig. 179. — A market garden should be near town.

Market Gardening. — Market gardening refers to the intensive commercial culture of vegetable crops generally grown near the larger cities, where land values are high.

Truck Gardening. — The growing of vegetable crops on an extensive scale is generally referred to as truck farming. Sections devoted to this kind of gardening are usually more distant from a market, where land values are less than where market gardening is practiced. Usually such crops as celery, tomatoes, and cabbage are grown which do not need such intensive culture as those produced by the market gardener. Very frequently, truck farming is restricted to the growing of one or two special crops, as the production of celery at Kalamazoo, Michigan, or of

Fig. 180. — Cultivating the home garden.

cantaloupes at Rocky Ford, Colorado. In many places, however, both market gardening and truck farming are practiced on the same farm.

Vegetable Forcing. — This is the most intensive type of vegetable production. It is frequently combined with market gardening and necessitates the use of glass houses for starting the crops early or growing them entirely under glass. Vegetables may be forced in greenhouses, hotbeds, or cold frames.

Selecting Varieties. — In producing vegetables for the home table, it should be the aim of the gardener to secure a uniform and constant supply. The kinds should be those preferred by the members of the family for whom they are grown. It is especially desirable to produce as great a variety as possible of the best and highest quality. Since the quality of vegetables depends much upon the variety, in selecting them, one should remember that the important commercial varieties are not always the best for the home garden.

Fig. 181. — A celery farm, Kalamazoo, Michigan.

Very frequently, varieties of high quality are not good yielders or the best for shipping, and are, therefore, not the most profitable. In the commercial vegetable garden, earliness is also a most important character. The grower

who is able to market his produce a few days ahead of his neighbor usually receives a much higher price. Early harvesting often enables the grower to prepare his land in time for a succeeding crop.

Location. — The garden should constitute an attractive feature of the home grounds. It should be placed as near the dwelling as conditions will permit. Since vegetables must be cared for at odd times and gathered at frequent intervals, it should be convenient for these purposes.

The location of a commercial garden is of no less importance. It is very desirable to be near a good market where the grower may keep in touch with the demand and deliver his product quickly at a minimum expense.

Soil. — Sandy loams with porous subsoils are generally considered the most valuable for garden purposes. Wet land, unless it can be satisfactorily drained, should be avoided, as good crops cannot be produced upon poorly drained soil. As the market gardener fertilizes very heavily, the physical composition of the soil is of greater importance than the amount of plant food it contains. A few of the vegetable crops require special soils, although most of them may be grown upon all the good agricultural lands.

A coarse, sandy soil is commonly regarded as a "quick" soil, as it dries out and warms up early in the spring. Coarse sands, though they produce early maturity, require a larger amount of vegetable matter in the fertilizer. Medium sands though not early are more productive and retentive of moisture. The silt and clay soils are often preferred for late crops. The muck lands, since they require less addition of plant food, are the most profitable in producing late-season crops.

Climate. – Climatic conditions determine the value of a section for vegetable production. Localities having an early season can produce vegetables and place them upon the markets of the less favored regions at a good profit. Many sections of the South, because of favorable climate,

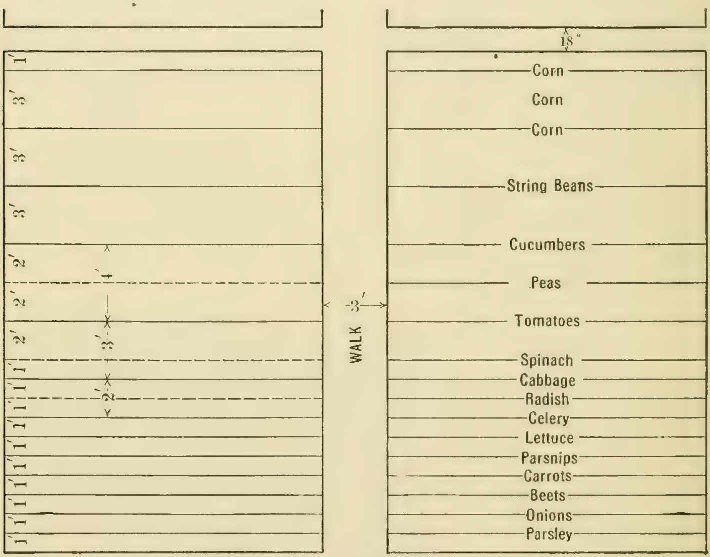

Fig. 182. — A garden plan.

have developed into large trucking regions. Certain sections of Michigan and New York annually produce celery because their moist, cool growing season proves especially favorable for this crop. Onions are grown in the Connecticut valley, peas in Wisconsin, potatoes in Maine, and cauliflower on Long Island because the climate of these sections is especially adapted to the production of such crops.

Air drainage is as important in vegetable production as it

is in fruit growing, especially in maturing crops for an early market. The necessity for irrigation is becoming more apparent. A constant and cheap water supply is a requisite for this purpose. Good roads, good shipping facilities, and a location where labor may be cheaply and readily obtained are other important factors.

Planning the Vegetable Garden. — A well-thought-out plan is essential to success in vegetable gardening. The arrangement of the crops with reference to each other is of first importance. Usually it is better to place the perennial vegetables together and arrange the other crops in such a manner that those grown about the same distance apart will be adjacent to each other. The garden should be arranged in such a manner as to economize labor. On the farm where plenty of land is available and labor scarce, the rows should be far enough apart to permit the use of a horse cultivator, but where the area is limited and close planting is necessary, the crops must be cultivated by hand. Since it is necessary in the market gardens to get as large returns as possible from a given area, companion cropping and succession cropping are practiced. In companion cropping, two or more crops are started on the

Fig. 183. — Cultivating peppers growing between rows of mature onions.

land at the same time, one of these crops being removed before the other crop needs the entire space. For example, cabbage may be interplanted with lettuce, or radishes may be planted between rows of beets, carrots, or parsnips.

The market gardener may start a crop on his land in early spring for early summer harvest and at that time start another crop to be harvested in the fall. In the Southern States, three crops are frequently grown in succession. In the North, however, but two crops can be grown in this way. Market gardeners frequently plant beets, cabbages, and onions in early spring, harvesting them in July. The land is then planted to celery, which is harvested in the fall. Rutabagas, turnips, spinach, and late cabbage are also commonly grown as a second crop. This system of cropping is called succession cropping.

Rotation. — For the vegetable garden, crop rotation is important. Different plants differ in their food requirements. Some crops require a liberal supply of nitrogen, while others demand more potassium. Crops that are grown annually upon the same land are most subject to serious injury from diseases and insect pests. All of these points should be carefully considered, not only that the crops may mature at the most desirable time and with the least expenditure of labor, but also that all portions of the land may be used to the best advantage.

Disease Prevention. — No vegetable crop is entirely immune from diseases. Of the preventive measures, spraying is of first importance. The spores alighting on the surface of the fruit or foliage may be killed by spray mixtures during their germination. Rotation is also an important means of preventing disease, as many of the spores live over in the soil from year to year. New land is,

therefore, generally free from these spores. The selection of resistant varieties is another important means of preventing disease. The purchase of seeds from infected sections is a common means of spreading diseases, for the spores of many diseases are carried on seeds from place to place. The treatment of seed to kill the spores is therefore an effective method of disease prevention. Many diseases are also carried in the manure. Throwing old diseased plants in the compost or manure pile and afterwards spreading this on the land is a very common method of infecting crops from season to season. All refuse from diseased plants should be destroyed.

Fig. 184. — Barrel sprayer.

Destroying Insects. — Insect attacks can be prevented best by spraying. In spraying, it is necessary to apply the spray as soon as the insects appear, as it is easier to control them at that time than after they become numerous. Successful spraying depends largely upon selecting the most effective spray and upon doing the work thoroughly and at the right time.

There are many spray pumps used for vegetable gardening work. The bucket sprayers are the most serviceable to use where the crops are either too close together or too far advanced to use the barrel or power sprayers. Barrel pumps are the most satisfactory for general crops, as they are cheap and require less labor than the hand sprayers.

Traction sprayers may be used for many crops and are the most convenient for general use.

In the selection of nozzles for vegetable spraying, it is important to select those that throw the spray in the finest mist and with the greatest force. The type used will vary with the pressure carried and the crop that is to be sprayed. The Vermorel and the Disc nozzles are two popular standard types. (See Chapter VIII.)

EXERCISES

1. Distinguish between home gardening, market gardening, truck gardening, and vegetable forcing.

2. Name the desirable characteristics of a good home variety of a vegetable. Of a market variety.

3. What are the requisites of the location of a home vegetable garden? Is your home garden located in accordance with these rules? How might it be changed so as more nearly to conform to them?

4. What is the principal vegetable crop grown in your region?

5. What type of soil is preferable for a garden spot? Has your garden at home a single type of soil or has it many types? Bring to school samples of as many types as you can find in your own vegetable garden.

6. Give the advantages and disadvantages of the following kinds of soil for vegetable production: coarse sand, medium fine sand, clay loam, stiff clay, and muck.

7. Draw accurately and to scale a diagram of the way your home garden was planned last year, locating accurately the plots in which the various vegetables and bush fruits were grown. Measure the garden and accurately compute its area.

8. Make a plan of your home garden as it would be if you could alter it in any way you think advisable.

SCHOOL GARDENING WORK

1. Each student should be assigned a plot of ground at least 10 by 25 feet in size. Larger individual gardens are often desirable. The several plots should be divided by main walks 3 feet in width and secondary cross walks $1\frac{1}{2}$ or 2 feet in width. The arrangement of these gardens depends much upon the shape of the particular piece of land available.

A novelty garden, general garden, hotbed, and a demonstration plot in which each exercise may be actually demonstrated by the teacher are also desirable adjuncts of the school garden. The borders of the school garden may be surrounded by narrow gardens where the girls may be given instruction in flower gardening.

2. After informing the students of the list of vegetables that are to be grown, each one should make a plan of his garden, drawn to a definite scale in his notebook, showing the arrangement of the vegetables, distance apart of rows, succession cropping, and companion cropping.

3. Prepare a page in your notebook and keep records as called for in the following table:

Date of Planting	Varieties	Up Date	Blooming Date	Used Date	Continued Bearing

4. Prepare an account sheet in your notebook as follows and keep record of expenses and receipts.

Date	Paid Out	$	¢	Date	Received	$	¢
April 10	For seeds		75	July 25	For doz. ears of corn		15

CHAPTER XIV

MANURE AND COMMERCIAL FERTILIZERS

Stable Manure. — Stable manure is the most valuable fertilizer for growing vegetables; and market gardeners depend mainly upon it. It not only adds nitrogen, phosphorus, and potassium, the three essential elements of

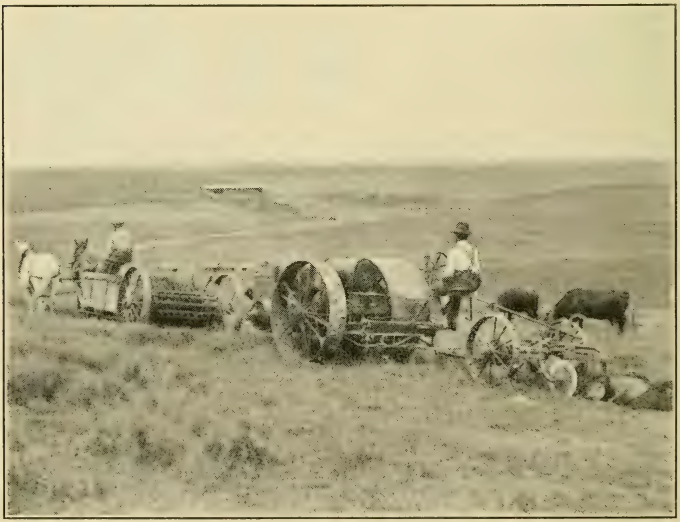

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Fig. 185. — Manure spreader followed by gang plow drawn by tractor.

plant food, but also large quantities of vegetable matter to the soil, which improves the texture of the soil and increases its water-holding capacity.

The general farmer applies manure to the land as soon as possible after it is produced. In truck farming also, where the vegetable crops are in a rotation with grass or clover, this is a commendable practice; but fresh stable manure is not suitable for intensive culture, because it is not quick enough in its action and its coarse texture prevents thorough incorporation with the soil. Fresh manure is likely to cause a rank growth of tops at the expense of the fruit or root. For example, it causes tomato plants to run to vine and may cause onions to produce a large percentage of "thick necks" or "scallions." Fresh manure often contains a large number of weed seeds that may prove very troublesome. Composting destroys weed seeds. Well-decomposed stable manure is the best for vegetable gardening.

Time to Apply. — The proper time to apply manure depends upon its kind, its condition, the crops to be grown, and the rotation to be followed. If clover or grass land is to be prepared for a vegetable crop, the manure should be applied before plowing. If the manure is well decomposed and of a limited quantity, it is desirable to use it as a top dressing after plowing, thoroughly harrowing it into the soil. If two or more crops are to be grown in rotation during the same season, it is good practice to apply a portion to each crop. On soils of rather low fertility, it is a common practice to manure in the hills or rows, as this secures a greater concentration of the plant food in the region of the roots of the plants.

Amount to Apply. — The amount of manure that can be most profitably supplied depends upon the kind of crop grown, the soil, and the available supply of manure. Market gardeners usually use from 25 to 50 tons per

acre each year, while the truck growers generally apply 15 to 25 tons annually. If a commercial fertilizer is used to supplement stable manure, this amount may be considerably reduced.

Commercial Fertilizers. — It is seldom that fertilizing with commercial fertilizers cannot be practiced profitably by the vegetable grower. This is particularly true when an adequate supply of animal manure is not available. Manures are richer in nitrogen than in phosphorus and potassium, and hence even where large quantities of stable manure are used, increased production usually results from the addition of these two elements of plant food. Some forms of commercial fertilizers, too, are more quickly available than manure and hence earlier crops may be produced by their use. Vegetables of a higher quality are also possible, as slow growth is likely to produce bitter, tough, and stringy vegetables.

Fig. 186. — A heavy crop of onions. Grown on muck land to which commercial fertilizers were added.

Nitrogen. — Nitrogen is the most important element of plant food to be supplied on the light sandy soils. In the growth of lettuce, spinach, celery, and other foliage crops,

nitrogen plays a most important part in producing an abundance of tender succulent leaves. It is the most expensive element of plant food.

Nitrogen may be purchased in many forms. Nitrate of soda is used in comparatively small amounts and applied at intervals of ten days to two weeks. If applied all at one time, a large proportion is lost by leaching before the plants are ready to take it up. A common practice is to use a little at the time of planting, followed by other applications as the crop develops. Sulphate of ammonia, not so quickly available, is used to supply nitrogen during a longer season of growth. All the organic forms of nitrogen, as dried blood and tankage, must decay before the nitrogen becomes available.

Phosphorus. — Phosphorus aids in maturing the crop and producing maximum yields. Many soils are lacking in this element. Acid phosphate, bone meal, and raw rock phosphate are common sources of this element.

Potassium. — Sandy soils and muck lands are likely to be low in potassium. Root crops require a bountiful supply of this important substance. Muriate of potash and sulphate of potash are the most common forms used by commercial gardeners.

The amount of commercial fertilizer that can be profitably used varies from 300 pounds to one or two tons per acre. Where two or more crops are grown annually upon the same land, the commercial grower endeavors to apply a small excess of all the essential fertilizer elements needed by the crops. One ton to the acre for a single crop is considered a liberal application, and it is seldom that larger amounts are profitable.

Lime. — Few crops thrive in sour soils. It is highly

important to keep the garden soil slightly alkaline, and this requires the occasional use of lime. Many of the soils are infertile because of acidity which prevents the growth of the soil bacteria that are essential to decomposition. Liming also promotes the growth of bacteria and makes plant food available. A thousand pounds of air-slacked lime to the acre is usually sufficient on most soils. This should be applied broadcast over the soil and harrowed in, care being taken not to mix it with horse manure, as it releases the nitrogen in the manure. If applied in the spring, it should be spread two or more weeks before seeding.

Mixing of Fertilizers. — For the home garden, it is usually most convenient to purchase high-grade commercial fertilizers already mixed. In commercial vegetable growing, there are many advantages in the home mixing of fertilizers. The grower can compound the mixture in such proportions as best suits his particular needs, and thus know the kind and amount of each fertilizer used.

Fertilizers may be mixed upon any tight floor. If nitrate of soda or potash salts are used, they should be crushed fine before mixing. The light materials, as dried blood or tankage, should be put on the bottom of the floor and the other materials spread over them. The materials are then thoroughly mixed by shoveling the pile over several times. After mixing, the fertilizer should be bagged and kept in dry storage until ready for use. One of the chief advantages of buying factory-mixed fertilizers is that they are more uniformly mixed.

Cover Crops. — Many truck growers find the practice of cover-cropping the most economical method of supplying humus. Sometimes this cover crop is left to grow for a year or more and forms one of the crops of a rotation.

Growers that practice this method are not troubled so much with injurious insects and diseases as those who are forced to produce the same crops on the same land year after year. (See paragraph on cover crops in connection with fruits, Chapter VI.)

EXERCISES

1. Name the three fertilizing elements that are contained in manure and commercial fertilizers.

2. What are the objections to the use of fresh stable manure in market gardens?

3. Name three fertilizers that are rich in nitrogen, three rich in phosphorus, two rich in potassium.

4. What soil condition makes necessary the addition of lime?

5. What is a cover crop? Is clover a good cover crop? Why?

HOME PROJECT

In fertilizing the home garden use a moderate amount of well-decomposed manure over the entire area. Supplement this on one half the garden with a dressing of acid phosphate applied at the rate of 300 pounds per acre. Keep date in notebook to prove results.

CHAPTER XV

TILLAGE AND IRRIGATION

The yield and quality of a vegetable crop depends much upon tillage. The objects of tillage are as follows: (1) to improve the physical condition of the soil; (2) to preserve and control the soil moisture; (3) to modify soil temperature; (4) to destroy weeds and to cover humus-producing materials, as manure or cover crops; (5) to aërate the soil and thus hasten its chemical action and make plant food soluble.

Plowing. — In the Middle West, fall plowing is preferred. The broken furrows collect water, hence a maximum supply of soil moisture is assured, and on sod land, the sod has time to decompose. Fall plowing destroys many insects and thus reduces their injury to the crops. Fall-plowed land may be harrowed and planted earlier in the spring.

The proper depth of plowing depends upon the crop to be planted as well as upon the natural depth of the top soil. Deep plowing is usually best for vegetable crops although the turning up of subsoil is always detrimental to these crops.

Harrowing. — Fall-plowed land should be harrowed as soon as the ground is fit to work in the spring. If plowed in the spring, the ground should be harrowed immediately after plowing.

The function of harrowing is to pulverize the soil and smooth the land. Disk and cutaway harrows are especially

valuable and are most suitable for heavy sod lands and clay soils. The spring-tooth harrow is often used after the disk or cutaway harrows to pulverize and level the land further. In vegetable gardening, one cannot prepare the soil too finely, as it insures uniformity of depth, moisture, and temperature for the seeds. Raking with hand rakes after harrowing is a very expensive practice. A smoothing harrow does the work of a steel garden rake in making the soil very fine. The plank drag is used by many market gardeners to prepare a very fine, smooth surface for small seeds and delicate seedlings.

Cultivation. — The most important function of cultivation is to preserve soil moisture. Although it is also the

Fig. 187. — Hand cultivation of sugar beets.

most economical means of destroying weeds, this is really a secondary matter.

In growing onions, radishes, lettuce, and similar crops, the rows are generally too close to permit the use of horse cultivators. Hand cultivators, therefore, are most important tools in the general intensive garden.

Cultivation should begin as soon as possible after seeding. After the seedlings appear, it is best to cultivate every week or ten days and after every hard rain. The depth of cultivation depends upon the kind and size of the plant. ,

Hand hoeing is not so efficient as cultivating with horse or wheel cultivators. If hand hoeing is practiced, it should be done before the weeds are large or it will prove both tedious and expensive.

Economical and efficient work can only be accomplished with good tools, hence the following points may be profit-

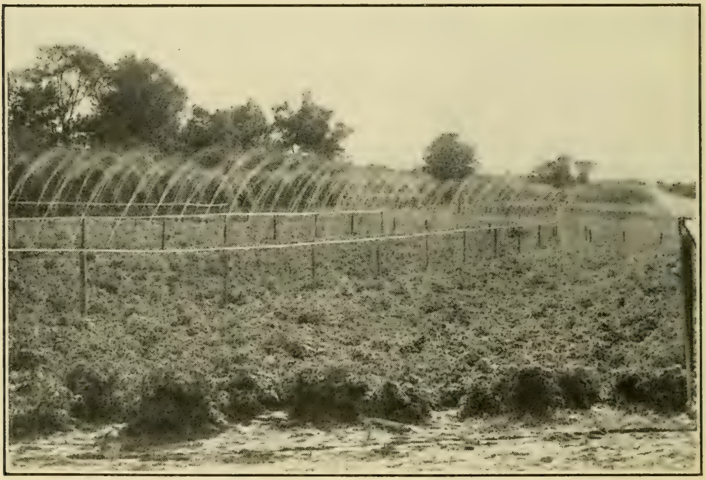

Fig. 188. — Overhead irrigation of tomatoes.

ably observed: (1) keep all implements and tools under cover when not in use; (2) keep them in good repair; and (3) clean all tools before storing.

Irrigation. — The necessity of insuring garden and truck crops against unfavorable weather conditions is

highly important. The investment in the crop is so large that the grower cannot always afford to depend upon seasonal conditions for its success. Hence, irrigation in humid regions often becomes necessary to protect a crop against droughts.

Water applied at the right time produces large yields of high quality and earlier maturity. Seeds cannot germinate without moisture, and transplanting often fails during hot, dry weather. Irrigation promotes continuous growth and development from the time the crop is seeded until maturity. Greater benefits are also obtained from the fertilizers when an abundant supply of moisture is at hand, as water is not only a solvent for plant foods, but also serves as a medium in their distribution.

Various methods of irrigation are practiced by vegetable growers. In the West, the furrow method is most generally used. The land must be properly graded, however, for carrying the water to the various parts of the garden by this system. On porous soils or on land of uneven contour, it is not desirable.

Underground tile may be laid a foot to one and a half feet in depth, in lines about ten to fifteen feet apart throughout the field. This is a good system, as the crop is watered from underneath and there is less loss by evaporation. The foliage of the plants is not wet and there is less liability of injury from fungous diseases.

In the overhead system of irrigation overhead lines of pipe about twenty-five feet apart are supported on posts and run across the field. Openings about four feet apart are made in this pipe, into which small nozzles are inserted. These throw a fine mist over the crop. The advantages of this system, which is popular with market gardeners,

are as follows: (1) the water falling in a fine spray prevents the washing and packing of the soil; (2) the water is distributed uniformly over the crops; (3) it requires very little labor to operate the system.

EXERCISES

1. What are the objects of tillage?
2. What is the chief object of cultivation? What is a soil mulch?
3. What is the effect of working soil when it is too moist? What is the effect of tilling soil when it is too dry?
4. How many times do you usually cultivate your garden?
5. What rules should be observed when caring for tools? How many of these do you observe?
6. Explain the various methods of irrigation. With your local conditions, which system would prove most practical? Do you think it would pay?
7. Visit a garden that has an irrigating system when the system is in operation.

SCHOOL GARDEN WORK

It is desirable to have the entire school garden manured, plowed, and harrowed as early in the spring as the soil can be properly handled. From a plan drawn to a definite scale of the entire school gardening plots, the students should be assigned a definite portion of the work in the staking out of the walks and gardens. This should constitute a valuable exercise in measuring, sighting, and working from the plan to the garden. Each student must be held responsible for a certain definite portion of this work.

Each student should then thoroughly rake and smooth off his assigned garden, square up the boundaries of the garden, and tidy up the walks surrounding it.

HOME PROJECT

Select a plot of ground at least 32 feet by 32 feet. Plow half of this plot in the fall and half in the spring. Cultivate each plot in the spring at least once a week until planted. Fertilize each plot the same and seed or plant to some common vegetable crop as spinach, onion, cabbage, or tomato. Cultivate half of each plot once every week, and the other half once every two weeks. Make a plan of the garden showing the four plots and keep a detailed record of the date, labor, and method of performing the work. Every two weeks during the growing season and at harvest time note the comparative condition of each plot.

CHAPTER XVI

GLASS STRUCTURES AND CARE OF GREENHOUSE CROPS

In producing early vegetables glass structures are essential. These are used both as a means of starting plants early in the spring and of growing crops during the winter season when it is impossible to produce them out of doors.

Hotbeds. — Hotbeds are the simplest and cheapest forms of heated glass structures. A well-drained spot, protected

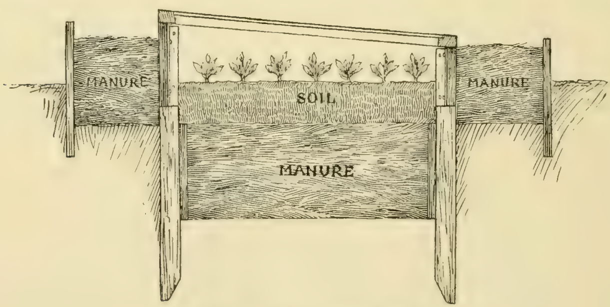

Fig. 189. — Cross section of a hotbed.

from the north and west, conveniently located, and accessible to a liberal supply of water, are the essential conditions governing their location. The heat furnished the beds is usually produced by the fermentation of manure. Since from fifteen to thirty inches of manure is required, a pit should be dug one and a half to three feet deep. For starting plants that require high temperature for a long

period, the greater depth is desirable. The pit is dug in the fall before the ground freezes and protected with leaves or manure during the winter. It should be of the same width as the length of the sash and of any desired length, and should extend east and west. The frame may be made of wood, brick, or concrete. The north side of the frame should be about six inches higher than the south side, to give the bed the proper exposure.

For hotbeds, fresh horse manure containing a large portion of straw is preferred. This is stacked in a shed or other protected spot in piles four to five feet wide and about four feet high. After two or three days, these piles should be forked over, and three or four days later shoveled into the pit. The frame is also banked outside with manure. In filling the pit, the manure should be placed in successive layers of five or six inches and thoroughly tamped down, especially along the sides of the frame. From four to six inches of good soil is then spread over the top. If a thermometer is thrust into the soil, it will be noticed that the temperature rises considerably for a day or two. After it has receded to about 80° Fahrenheit, the bed is ready for use.

Muskmelons, cucumbers, lettuce, tomatoes, and many other vegetables may be started in the hotbed and later transplanted to the field. Hotbeds are largely used for growing and maturing such crops as radishes and lettuce. In the fall, they are often used for maturing late crops.

Cold Frames. — A cold frame is even simpler than a hotbed, to which it is quite similar except that no bottom heat is supplied, hence it is not necessary to dig a deep pit for its construction. A cold frame is built on the surface of the ground, using a twelve-inch plank for the upper side of

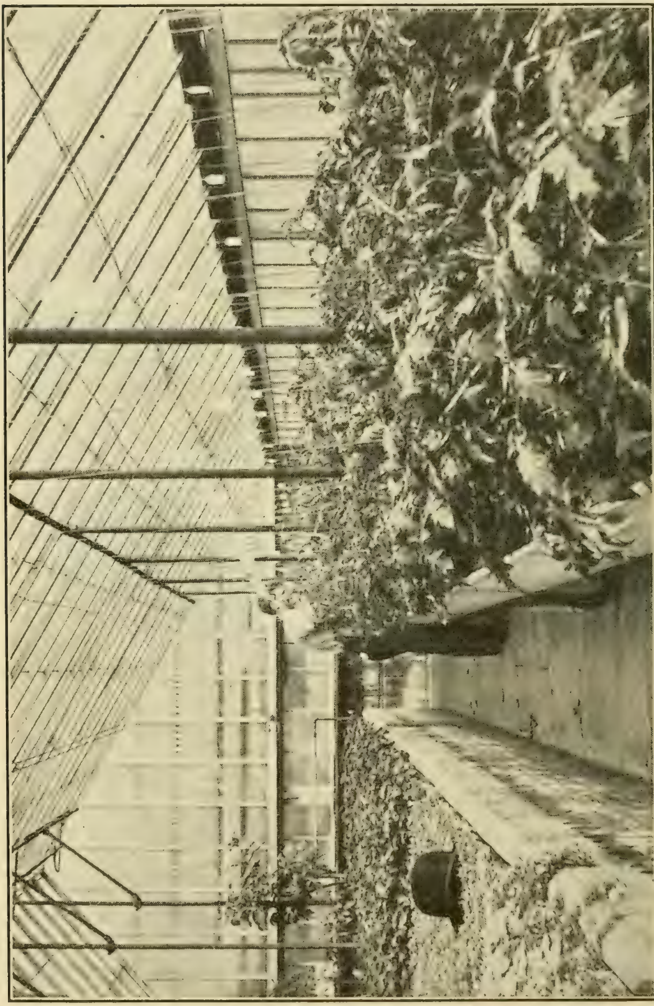

Fig. 190. — A typical up-to-date greenhouse.

the frame and a six-inch plank for the lower side. The location and general construction is otherwise very similar to that of the hotbed. For some crops, it is desirable to dig a shallow pit in order to provide room for the tops of the plants. For example, to grow tomato plants, it will require a deeper frame than for radishes or lettuce. These frames are easily moved from one place to another and are often used to force plants in the spring that have been previously started in the fall. Their chief function is to grow plants that have been previously started in the greenhouse or hotbed, and to harden plants that have been grown in the greenhouse, before setting them in the field. The cheapness of their construction makes them extremely desirable.

Greenhouses. — The out-of-season demand for many of the vegetables has resulted in the construction of large greenhouses. These have many advantages over hotbeds. The conditions of temperature and moisture can be definitely controlled and crops can be produced during the most unfavorable weather. They provide profitable employment for the market gardener the year round and are also valuable for starting early plants to be later transplanted to the field.

In selecting a location, it is desirable to choose a site that is protected from the north and west, that has a good exposure to the south, and that is unshaded by other buildings.

Construction. — The heat and moisture within a greenhouse causes rapid decay of wooden parts. Cypress and cedar are the most durable kinds of wood and are therefore largely used for this purpose. Probably the most practical form of construction is what is known as the semi-

iron type. Such greenhouses are built with concrete walls and with the interior braces and supports of iron pipes. The roof bars and other wooden parts, if made of cypress and painted every year, will last for some time and may then be replaced without a large expense. The construction should be such as to provide a maximum amount of light.

A greenhouse should have ample provisions for thorough ventilation. Ventilators are placed at one or both sides of the ridge and frequently extra ventilators are placed along the sides of the house. It is the aim to place the ventilators in such a manner as to prevent cold drafts from striking the plants and to provide ample ventilation during all kinds of weather.

Greenhouses are heated by steam or hot water. The larger greenhouses are generally heated by steam. Hot water is preferred for heating small houses, as the pipes retain heat for a greater length of time and the boiler may be left longer without attention.

Soils. — A well-drained soil of good texture containing an ample supply of plant food is required for greenhouse culture. Usually a sandy loam is preferred, although muck soils are frequently used. Where large quantities of soil are required, a suitable garden area is selected in the spring and given a heavy coat of stable manure. The land is then plowed and afterwards harrowed repeatedly during the summer. By fall, it is in excellent condition for use. If a smaller quantity of soil is required, it may be prepared by composting. A good blue grass sod is selected and stacked in alternate layers with manure. It is then left to decompose. After standing for about a year, the pile is shoveled over two or three times at intervals of a few weeks, and is then ready to use.

Temperature. — The proper temperature for vegetable forcing varies greatly with the kind of vegetables. Lettuce and radishes grow best at a comparatively low temperature, while tomatoes and cucumbers demand a high temperature for their best development. Plants grown at too high a temperature produce weak, spindling stems and are very susceptible to disease. If the temperature is too low, it seriously weakens the plants and stunts their growth. The temperature at which plants may be maintained also varies with the general weather conditions. During bright sunny weather when plenty of ventilation may be given, the temperature may run considerably higher than is desirable under other conditions. During a prolonged dark, cloudy period, it is better to maintain a lower temperature than the plants ordinarily demand. It is always the practice to maintain the temperature fifteen to twenty degrees lower at night than during the day. A greater difference of temperature than this is seldom desired and is usually harmful.

In controlling the temperatures of hotbeds, it is a common fault of the beginner to allow the bed to cool off too much during the afternoon before replacing the sash. All hotbeds, especially during the early spring, should be covered early in the afternoon to prevent chilling the plants. In ventilating them during cool weather, the sash should be opened in such a manner as to prevent cold drafts from striking the plants. During dark, cloudy weather, hotbeds need little ventilation.

In order to control the temperature of hotbeds, it is frequently necessary to provide additional protection. Mats made of rye straw are commonly used to cover the sash during severe weather. Burlap mats stuffed with

cotton waste are also used for this purpose, although they are less satisfactory.

Watering. — Plants growing under glass need careful watering. During bright sunny weather, when the plants are growing very rapidly, they need much water. During bright weather, most crops have to be watered daily, while during cloudy weather, they may not need water

Fig. 191. — Watering the plants in a hotbed.

for a week. As most fungous diseases of vegetables thrive under warm, moist conditions, all greenhouse crops should be watered early in the morning on bright days, that the foliage of the plants may dry before night. The soil should be thoroughly moistened as deep as the roots extend. Watering in the evening not only increases fungous growth but also tends to chill the bed and thus increase the danger of frost.

EXERCISES

1. Make a working drawing of a hotbed 12 feet by 6 feet, showing the back of the frame 6 inches higher than the front and a pit 2 feet deep, filled with 12 inches of manure, and covered with about 4 inches of soil.

2. If there are any greenhouses in the neighborhood, make a trip to see them, taking notes on the method of heating, width of glass, ventilation, and the crops raised.

3. Draw a diagram of a cold frame to grow tomato plants.

4. What are the principal requirements of a good soil for greenhouses?

SCHOOL GARDEN WORK

The class should construct a hotbed in the school garden. Note in detail the material used in construction and estimate the cost of the material; also describe the general method of procedure in its construction. Insert a soil thermometer in the soil after finishing and note the temperature of the soil each day until ready for seeding.

HOME PROJECT

Make a working drawing of a hotbed covering at least 36 square feet of space. Estimate the material required for the same. Construct the hotbed at least a month before outdoor planting weather. Sow tomato, cabbage, celery, cantaloupe, and other vegetable seeds to produce a sufficient supply of these plants for the home garden. Seed the remainder of the bed to lettuce and radish. Ventilate, water, and otherwise care for the bed as outlined in the text. Transplant at the proper time, and harden plants before transplanting to the field. Keep an accurate record of each day's work.

CHAPTER XVII

SEED SOWING AND TRANSPLANTING

SUCCESS in vegetable gardening depends primarily upon good seed. The most fertile soil and the best care cannot produce profitable crops with poor seed. Good seed must possess the following essential requisites:

1. Must be true to name. It is usually easy to tell by the external characters the kind of seed, although one cannot determine the variety.

2. Must be viable; that is, a large percentage of seeds should under favorable conditions produce vigorous plants.

3. Must be free from weed seeds and other impurities.

Seed Sowing. — In sowing seeds, success depends largely upon the proper preparation of the seed bed. If the soil is coarse and lumpy, a good stand of plants cannot be obtained. Each particle of soil is surrounded with a film of water, and when a large number of these are brought into direct contact with the seed, a sufficient supply of moisture is assured. If the soil is a stiff clay, devoid of humus, and firmly packed, the seeds will also fail to grow because of the lack of air. A soil well filled with humus should be selected.

The time to sow vegetable seeds depends largely upon the temperature of the soil and the time it is desired to market the crop. Seeds, such as lettuce, beets, and onions, will germinate at a temperature of 50°, while other seeds, as tomato, eggplant, and beans, require a much higher

temperature. Hence, the former crops may be planted early in the spring, while the latter should not be sown until the soil becomes thoroughly warmed and there is less danger of subsequent cold spells. Seed should be sown as soon as possible after the soil is prepared. Better results are always obtained from sowing seed in freshly stirred soil.

The depth of sowing depends largely upon the size of the seed, the season, and the character of the soil. Large seeds may be planted deeper than small seeds. With some of the smaller seeds, as celery, it is a common practice simply to scatter the seed on the surface of the soil and press it in. In light soils, the depth of planting may be considerably greater than in heavy soils. In early spring, since the soil is usually very moist, seed is planted nearer the surface than in summer and fall seeding.


Fig. 192. — A seed drill.

With non-cultivated crops, broadcasting is often desirable. All cultivated crops are sown in drills. Seeds sown in this manner are at a more uniform depth and distance apart, and the plants may be cultivated, thinned, and cared for systematically. When the seed is sown by machines,

there is little difficulty in getting the rows perfectly straight and a uniform distance apart. In the home garden, lines should be used to secure straight rows. The seed should be dropped at a uniform distance in the furrow. Seed drills may be regulated to do this, but in hand seeding, it will be necessary to exercise care to secure an even distribution. After seeding, the furrows may be closed with the rake or hoe. With seeding machines, a roller attachment is generally used to firm the soil, but in hand seeding the soil can be pressed with the back of the hoe.

Transplanting. — Many of the vegetable crops are started in seed boxes or beds and later transplanted to their permanent quarters. In the arid regions, transplanting is not practiced so much as in the more humid sections where the weather conditions are more favorable for growth. Some of the most important reasons for transplanting are the following:

1. Crops such as tomatoes, cabbage, celery, and lettuce can be started very much earlier in the spring in hotbeds or greenhouses and later transplanted to the field.

2. Crops do not require as much space during the first few weeks of their growth and hence larger areas may be used for other crops. In this manner, two or more crops may often be produced in a single season from the same area.

3. Transplanting generally produces a more fibrous root system. In transplanting, the taproot and many of the small, tender lateral roots are broken, causing a branching of these roots.

4. The soil for seeding may be prepared extremely fine and the temperature definitely controlled. The seedlings may be easily and carefully watered at the proper time.

These advantages make it advisable to transplant certain vegetables into temporary quarters before the final transplanting into beds or fields. If celery, cabbage, or tomato plants are transplanted once before setting in the field, a better stand of plants is obtained.

Plants which have many small, fibrous roots can be transplanted most successfully. Cabbage, lettuce, and celery possess such root systems, while peas, melons, and other plants having relatively few fibrous roots are most difficult to transplant.

The plants should be set slightly deeper than they stood in the seed bed. There is less danger of setting too deep than too shallow. When the plants are tall and spindling, it is especially desirable to set them deep. Plants should be watered an hour or two before digging, and if the weather is hot and dry, should be kept well shaded until ready for setting. Just before a rain or during a dark, cloudy day is the most favorable time for transplanting. When large numbers of plants must be set, transplanting must be done at all times of the day regardless of the weather conditions. If the soil is exceedingly dry, it should be watered before the plants are set. An opening in the soil is then made with the dibble or trowel large enough to accommodate the root system of the plant without crowding. The plant is set with its roots well spread in the hole and the soil pressed firmly about it.

Transplanting machines are often used where large numbers of plants are to be set. These machines do the work better, more rapidly, and with less expense than is commonly done by hand. A narrow shovel on the machine opens a furrow, while two men seated behind alternately drop the plants into this furrow. As each plant

is dropped, a pint or more of water from a tank on the machine is dropped with each plant, and rollers, which follow behind, press the soil back into place.

Flats. — Shallow boxes commonly known as flats are used in sowing and transplanting early crops. They are made of any convenient size, depending largely upon the width of the greenhouse benches. They are usually about

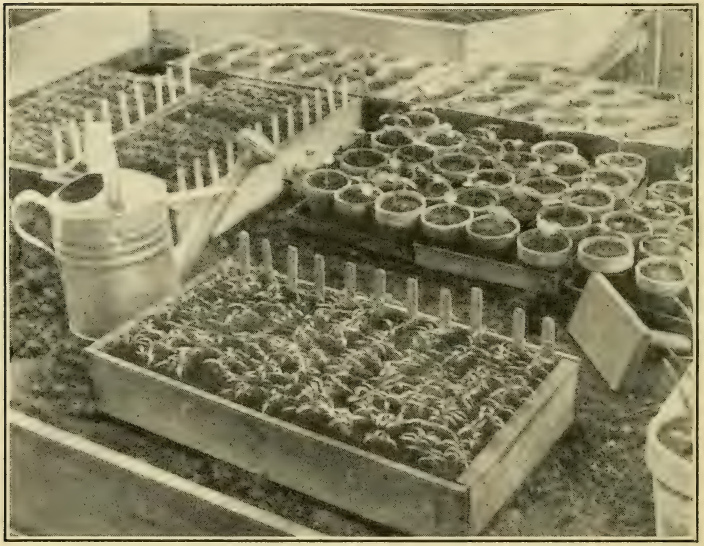

Fig. 193. — Tomato seedlings in a gardener's flat; cucumber seedlings in pots.

two and a half inches deep and of such a width and length as to be easily handled. A convenient flat may be made with end pieces three fourths of an inch thick and the sides and bottoms half an inch thick. One fourth inch cracks should be left between the bottom pieces to provide drainage. In growing crops in hotbeds, flats are especially serviceable, as seed sowing and transplanting may be done indoors.

Flats should be filled with soil of good texture and moist enough to work well. In filling flats, it is important that the soil be made perfectly level, for otherwise the seed will be washed in watering. With a straight-edge about a half inch thick small furrows about one and a half inches apart and a fourth of an inch deep should be made for the seed, beginning about half an inch from the end of the flat. After the seed has been carefully distributed in these furrows, it should be covered with a little soil which should afterwards be firmly pressed down. The flat should then be watered and placed in the greenhouse or hotbed.

As soon as the true leaves are formed the seedlings may be transplanted to other flats in which well-decomposed manure has been placed in the bottom and afterwards filled with soil even with the top of the box. After leveling and pressing down, the surface of the soil should be about half an inch below the top of the flat. The plants are then set in straight rows both ways. The flat should be set in a cool, shady place for a day and then transferred to the greenhouse, hotbeds, or cold frames.

Before such plants are transplanted out of doors they should be hardened. If they are planted directly from the greenhouse or hotbeds to the field, the soft, tender tissues of the plants cannot endure the low temperature and the cool, drying winds. In hardening them, water should be applied sparingly and air admitted to the frames more and more each day, until finally the sash is removed entirely during the day and replaced again at night. Such plants as cabbage, celery, and other hardy vegetables, if properly hardened before transplanting, will endure freezing, but if they are not properly hardened, they will be injured by slight frosts.

TIME AND METHOD OF PLANTING SEEDS

Seeds	Time	Distance Between Rows	Distance Apart in Row	Depth of Planting
Beans	After frost danger	2 ft.	3–4 in.	2 in.
Beets	Early	2 ft.	3 in.	1 in.
Cabbage	Early	3 ft.	2 ft.	Transplant
Sweet corn	Early	3 ft.	$2\frac{1}{2}$ ft.	2 in.
Cucumbers	After frost	4 ft.	$\frac{1}{2}$ in. 6–8 seeds	
Lettuce	Early	1 ft.	$\frac{1}{2}$ in.	$\frac{1}{4}$ in.
Melons	After frost	4 ft.	4 ft.	1 in. 6–8 seeds
Onion sets	Early	1 ft.	2 in.	2 in.
Peas	Early	2 ft.	1 in.	2 in.
Radishes	Early	1 ft.	$\frac{1}{2}$ in.	$\frac{1}{2}$ in.
Spinach	Early	1 ft.	$\frac{1}{2}$ in.	$\frac{1}{2}$ in.
Sweet potato	After frost	3–4 ft.	12 in.	Transplant on ridge
Turnip	Early and late	2 ft.	3–4 in.	$\frac{1}{2}$ in.
Tomato	After frost	4 ft.	3–6 ft.	Transplant

EXERCISES

1. Give the three essential requisites of good seed. Which one of these do you consider of most importance?

2. Examine samples of commercial seed bought at the local market for evidences of weed seeds, grit, and other impurities. Determine the per cent of each by weight.

3. How do you plant seeds at home? Do you plant them all at the same depth?

4. Name the four important advantages of transplanting. Which one of these is the one for which most of the transplanting is done in your locality?

5. Why should plants not be set out in the heat of the day?

6. Explain the proper method of filling a flat with soil. Of sowing seeds in flats. Of transplanting.

SCHOOL GARDEN WORK

(Each student should be assigned a definite space in the hotbed for starting early plants. It will prove more convenient if the seeds are sown into flats rather than directly into the hotbed soil. Cabbage, tomatoes, cauliflower, celery, lettuce, and such other crops as are desirable for transplanting to the garden should be seeded at such times as to be of good size at the proper period for transplanting out of doors.

Each student should be supplied with a separate flat. A flat 12 inches wide, 20 inches long, and 3 inches deep is convenient.)

Take one part of good garden soil, two parts of sand, and mix thoroughly. Sift the mixed soil through a sieve of about a quarter-inch mesh and spread the lumps over the bottom of the flat for drainage. Fill with loose, fine soil even with the top of the flat and press down firmly and evenly with a block. Beginning about three fourths of an inch from the right-hand end of the flat, make a shallow drill about a quarter of an inch deep with a small straight stick that is about half an inch thick. Distribute the seeds evenly in the drill so that they are about a quarter of an inch apart. On a small garden label, write your name or number on one side and the name and variety of vegetable, together with the date, on the other side. Place this label at the head of the row in the flat.

About one and a half inches from the first row, the second drill may be made and likewise the remainder of the flat may be filled. Label each row, if sown with a different kind of vegetable.

Cover the seed by sifting a little fine soil evenly over the flat and afterwards pressing it firmly with the block. Water gently to prevent washing and set the flat in the hotbeds in such a manner as to be perfectly level; otherwise, future waterings will wash the seeds to the lower side.

CHAPTER XVIII

HARVESTING, MARKETING, AND STORING VEGETABLES

Harvesting. — As market gardeners usually market several kinds of produce at the same time, the harvesting and packing of these crops is a complex proposition. The vegetables are usually harvested in the field, placed in special picking baskets or crates, and afterwards hauled to the packing house, where they are carefully sorted, graded, and packed for the market. Women are frequently employed for this work and are generally neater and more expert than men.

Packages. — It is often said that the package sells the product. A neat, attractive package should always be selected. It should be of such size as to be most convenient to handle and pack on wagon or car. It should be of such a character as to prevent bruising, heating, or other injury to the contents. Few containers are returned to the growers and it is necessary that they be inexpensive. The style of the container varies with market demands, and the container used for a crop in one section is often very different from that used in marketing the same crop in other sections. As a rule, in shipping first-class products, the smaller packages are desirable. The tendency in marketing to-day is to ship in such a package that the produce may be sold direct to the consumer without rehandling or repacking.

Marketing. — The profits in vegetable growing depend as much upon methods of marketing as upon methods of cultivation. Many gardeners are expert growers but poor market men. The details of marketing are just as im-

Fig. 194. — A good crop of tomatoes ready to be harvested.

portant as the details of production and must be as thoroughly mastered if the greatest profits are to be realized.

The success of a grower depends largely upon his ability to produce crops that satisfy the consumer. The user is the final judge. Quality is the first essential. Vegetables of high quality are often packed and shipped in such a manner as to spoil their market value. The appearance of the product as presented to the consumer is also important.

The product should be graded as to size, color, ripeness, and soundness, and packed in attractive receptacles. Besides these considerations, it is of great importance to

Fig. 195. — Preparing vegetables and fruits for market.

place the products on the market when the consumer is most anxious to purchase them.

Coöperation. — The problems of marketing may often best be solved by the growers forming a coöperative organization. In this way, the marketing is placed in the hands of an experienced manager who possesses ability for this work. This is advisable in localities devoting their attention to the growing of one kind of crop. As a rule, coöperative associations are formed mainly for the purpose of selling produce, but they may also buy fertilizers, packages, and other supplies for members, and build storage and packing houses for the produce. Such associations are found to-day in many sections of the country. The

management of the association is generally placed in the hands of a board of directors, who are elected by the members, and who in turn appoint a manager. The manager may be hired on a salary or on a commission basis, and in the larger association, he gives all his time to the work. In the smaller association, he usually works on a commission basis.

Distribution. — One of the greatest advantages of coöperative organizations is that they insure a proper distribution of the crops. Good distribution is almost impossible without organization. If the shipping of the crop is in the hands of one man who is in close touch with the supply and demand of each market, slumps in prices due to glutted markets may be successfully avoided.

Coöperative associations relieve the producer of the details and troubles associated with marketing problems. He can then devote all his energies to the producing end of the business. Associations should be able also to sell at uniformly higher prices than an individual producer, as a manager is able to keep in closer touch with the various markets, especially of the larger consuming centers. Shipments can be made on a larger scale, which means a greater saving in the cost of shipping as well as better transportation. Better prices are also obtained because the product may be uniformly packed under strict rules by laborers under the direct supervision of the manager. Uniformity in packages means the establishment of a reputation, and consequently a greater demand for the product. Indirectly, organizations have resulted in bringing the growers closer together. They become interested in each other's crops, and by the mutual exchange of ideas, become more intelligent and successful producers.

Storage. — Many of our vegetables are marketed as soon as possible after harvesting, while others are stored for short or long periods.

Moisture, temperature, and fresh air are the three storage factors that must be controlled. Root crops must be kept moist to preserve their firmness and freshness, but onions must be kept dry in order to prevent their decay. The temperature must be kept high for squashes, but for cabbages and onions it is important to keep it just above the freezing point. Thorough ventilation is also necessary.

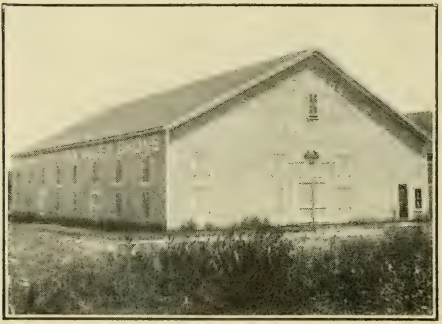

Fig. 196. — An onion storage house.

Vegetables that are to be stored should be mature and free from disease and mechanical injury. Cabbages are harvested just before they have matured, but onions, squashes, and many other crops should be well matured before storing. The construction of storage houses should vary with the kind of crops to be stored. Many of the vegetables grown in the home garden may be successfully stored in the house cellar if moisture, temperature, and ventilation can be controlled. Many cellars, however, are too warm and dry for the successful storing of these crops. When storing on a small scale, pits are frequently used, and being inexpensive and easily constructed, are very satisfactory. Beets, carrots, and other root crops are frequently buried out of doors. These crops are placed

in long piles two or three feet high and three or four feet wide at the base. These piles are covered with straw, and after the weather becomes colder they are further protected from freezing by a covering of earth.

EXERCISES

1. Make a table showing the methods of harvesting and marketing (by bushel or bunch), and the size of package for peas, beans, carrots, sweet corn, squashes, onions, radishes, cabbages, and beets in your community and the average price per unit last season.

2. Design a trade-mark and label which might be placed on all the goods you sell from the farm. Show by color, shape, or word that you guarantee your goods to be true to name.

3. Are there any coöperative associations of vegetable growers in your state?

4. Explain in detail the method of harvesting, grading, packing, and marketing of one important vegetable crop grown in your section.

CHAPTER XIX

LANDSCAPE GARDENING

Styles. — The three principal styles of landscape gardening are the formal or geometrical style, the natural style, and the picturesque style. The principles governing each style are so different that they can seldom be combined without discord. This is especially true in small areas, but on large estates different styles may be used and harmoniously combined.

The Formal or Geometrical Style is characterized by its regularity, symmetry, and geometrical forms. Trees planted in rows, walks and drives laid either in straight lines or geometrical curves, and water in fountains or basins are all characteristic features of the formal garden.

The Natural Style is especially adapted to the improvement of the farm home grounds. The principal characteristics of this style are large, open lawns of graceful curving surfaces; trees, shrubs, and flowering plants naturally disposed; and walks laid out with simple, pleasing curves. All forms in this style of landscape design should be free, flowing, and graceful, thus producing a natural effect.

The Picturesque Style also aims to produce natural effects although its method and style of presentation are quite different. Abrupt lines and irregular forms and figures are used rather than the smooth, simple, flowing lines of the natural style. Irregular groups of wind-swept pines on the top of a barren hillside with broken

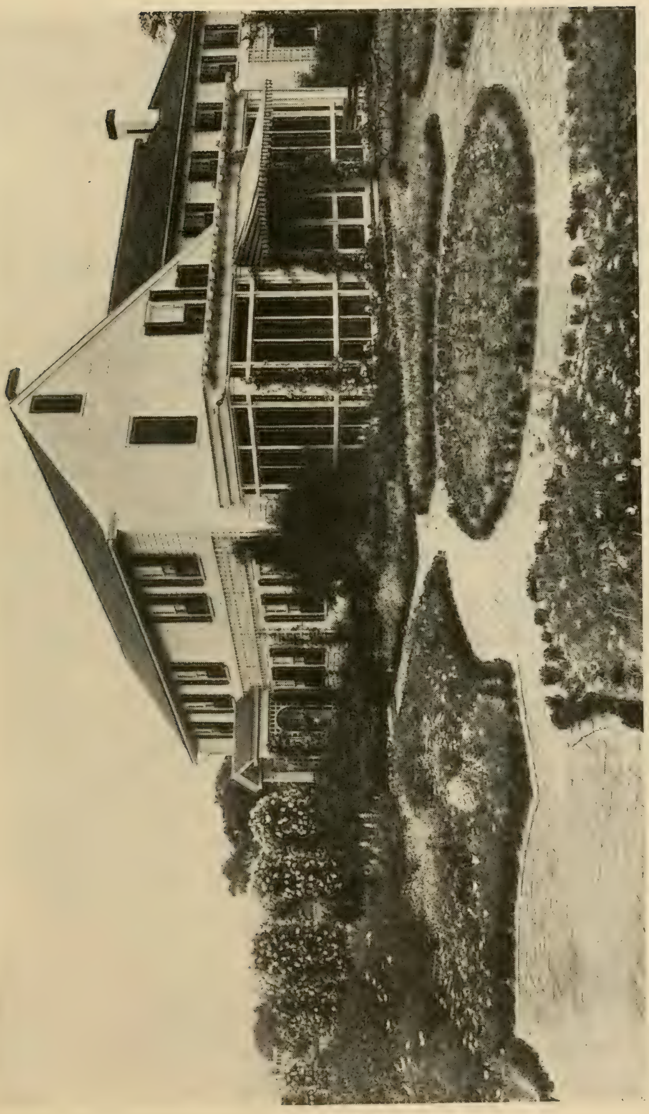

Fig. 197. — Country home with small formal garden.

banks and steep ravines present a picturesque type of beauty. This spirit of boldness, irregularity, and wildness may be enhanced in the designing of walks and drives and even in the buildings themselves when improving such landscape scenes by the picturesque style.

Each style of landscape gardening may be introduced with good effect in appropriate surroundings. In public squares or about stately buildings where gardens of a highly pretentious and elaborate character are desirable, the formal style is most suitable. Very frequently, too, in small gardens where variety and naturalness are impossible because of limited size, the formal garden is most appropriate. In the country where the surroundings are natural, either the picturesque or natural style is suitable. Where the land is rough and abrupt, or where some large bowlder or irregular group of trees determines the site, the picturesque style may be desirable; while in districts where the land is gently rolling and covered with maples, elms, and other smooth, round-topped trees, the natural style is to be preferred.

The purpose of landscape gardening is to arrange the buildings, walks, drives, lawns, and plantings so that they will best serve the purposes for which they are intended and still be combined in a pleasing manner. All home grounds possess elements of natural beauty, and the landscape gardener should perceive and enhance this natural beauty rather than attempt to create a different type.

Selection of Building Sites. — In the selection of building sites there are three things to be kept in mind; namely, soil drainage, air drainage, and exposure. A well-drained soil is the first requisite. Air drainage is of nearly equal

importance. Hollows in which cold, damp air collects are to be avoided. It is also important to select a site that is protected from the cold winds of winter.

It is important that the barns be well away from the house and so placed that the prevailing winds will carry

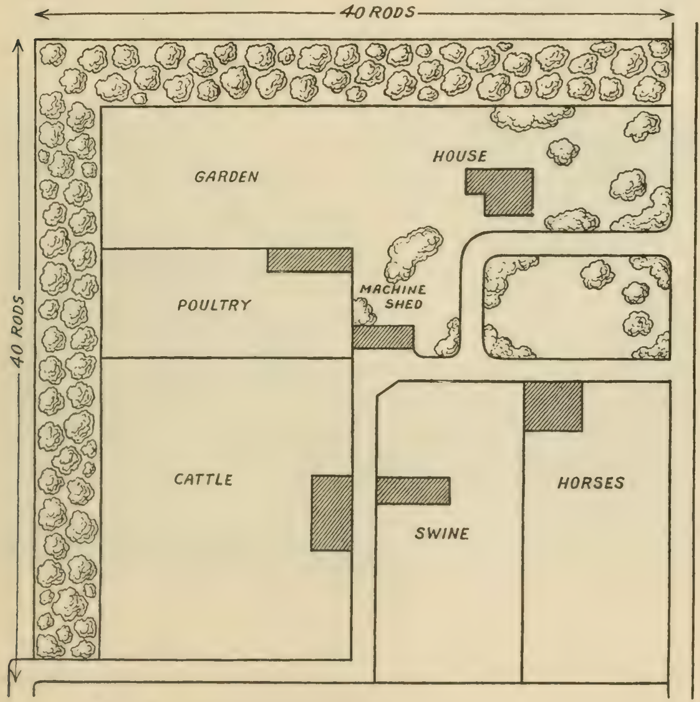

Fig. 198. — Arrangement of grounds surrounding a farmhouse.

the odor of the stables away from the house. The house should be situated some little distance back from the road and so placed as to have a commanding view of the country around.

Walks and Drives. — Walks and drives are elements of necessity rather than of beauty and should be so designed as to be convenient and direct. Dividing the grounds by walks or drives not only tends to destroy the unity of the design, but also to diminish the apparent size of the area through which they pass. Every precaution should be taken to preserve an open lawn, especially in front of the house. Roads and walks should be kept well to the bound-

Fig. 199. — Driveway leading up to a farmhouse.

aries wherever possible. Whether they should be straight or curved depends largely upon the size of the grounds, the contour of the land, and the general style of treatment. On areas of limited size, all walks and drives should be straight unless the contour of the land is such as to make curved ones more convenient. On larger areas curved walks and drives are more pleasing and graceful and should be used since they do not destroy the unity of the design.

The Lawn. — The lawn adds much both to the appearance and value of the property. Before trees, shrubs, and flowers can be properly arranged a good lawn is necessary. Its construction, therefore, deserves most careful consideration.

In the grading of the lawn one should endeavor to obtain good surface drainage. Except in formal work a level lawn should never be produced. It lacks the naturalness and variety that a lawn should possess. In grading a lawn the natural slopes and curves of the land should be preserved. Nature seldom produces perfectly level surfaces.

After the general slopes have been established, the land should be re-harrowed and the small, uneven places smoothed off. If the grading is begun in the fall and the land is then allowed to lie over winter, the soil will have become well settled by spring and will be ready for the final grading before seeding and planting.

A good soil is the first requisite in the construction of a permanent lawn. In changing a grade the top soil should first be carefully removed, the fill or cut made, and the top soil then replaced. After the grades have been established the soil should be thoroughly rolled and the small, uneven spots smoothed off with a hand rake and by a second rolling the surface made smooth and even.

Lawn Fertilizers. — If barnyard manure is to be used it should be plowed under or harrowed into the soil. Fresh manure is likely to contain weed seeds and its use should be avoided.

A commercial fertilizer may be used to advantage after the grass is well started, but it should never be applied at seeding time, as it may injure the young plants that come in contact with it during germination. Commercial fer-

Fig. 200. — A well-made lawn on a country estate.

tilizers are easy to apply, contain no weed seeds, and may be readily procured. Some of the most popular forms of commercial fertilizers for lawns are ground bone, wood ashes, and high-grade complete fertilizers.

Kinds of Lawn Grass. — The best grass for lawns is the Kentucky blue grass. Although this grass is rather slow in starting, it produces a permanent lawn of fine texture and of a rich green color. The crown of the plant sets very close to the ground and thus permits close clipping. After getting well established, Kentucky blue grass spreads very rapidly by underground rootstalks.

Of the rapid growing kinds that may be used for quick effect English rye grass is one of the best. Although coarse in leaf it starts rapidly into growth, and covers the ground which might otherwise be taken up by weeds. Redtop is another quick-growing grass, producing a good lawn effect the first season. It is of finer texture than rye grass but does not grow so rapidly. It is especially valuable upon poorer soils, in which it seems to thrive better than most other grasses. White clover is frequently used on lawns and makes very rapid growth. A mixture of blue grass, redtop, and white clover is excellent for new lawns. Bermuda grass is especially popular in the Southern States, but is easily killed by frosts. On very sandy soil the Rhode Island bent grass thrives well, while in very shady places the woodland meadow grass may be used.

Grass seed is likely to contain weed seeds that will prove troublesome. It is best to buy lawn grass seed from a reliable seedsman and to purchase only the purest grades on the market. If a large quantity is to be secured, a sample should be sent to the state experiment station to be tested for purity.

Sowing Lawn Seed. — In seeding a lawn, at least fifty pounds of seed per acre should be used. Thick seeding chokes out weeds and helps to produce a quick result. The seed should be sown when no wind is stirring, preferably early in the morning or late in the evening. To insure an even stand the seed should be divided into two equal parts. One part should be scattered lengthwise and the other crosswise of the lawn.

After sowing the seed, unless followed by rain, the soil should be rolled. Raking or harrowing the soil after seeding is likely to bury the seed unevenly.

Mowing the Lawn. — After the grass has grown to a height of from four to six inches it should be given the first clipping. Future cuttings should be made frequently enough to permit the clippings to remain on the lawn. These clippings form a mulch around the base of the plants and protect them from drying out during the summer months. Close cutting is a bad practice as all of the foliage is cut away and the soil about the roots is exposed directly to the wind and sun.

Planting the Grounds. — The laying out and planting the grounds is usually of more importance than the architecture of the buildings. Very ordinary looking buildings may be made attractive and homelike if the planting is properly done. Indeed the less prominent the architectural features the greater is the relative importance of planting. To unite the house with the roads, walks, lawns, and other surrounding features into one harmonious whole is the leading function of plantings.

Before a planting plan is made, the ground should be studied with reference to the arrangement that will prove most serviceable. The farm grounds consist of three parts,

each having separate functions. The first of these is the entrance division. This consists of the entrance roads, walks, and the front lawn, together with all plantings bordering on the same. As the impression gained from this division is the one by which the remainder of the property is judged, its appearance is most important. The front yard should be neat and simple, and of such a character as to suggest dignity and hospitality. The second division is the living division. It is the out-of-doors living room. On the farm this division is frequently combined with the first, although it is often desirable to have this portion of the grounds screened from the entrance and service divisions. The third is the service division and is the most necessary division of the farm grounds. It is commonly called the back yard. It is necessary to have some place for the entrance of supplies, the outgoing of wastes, the storage of garbage, ashes, and wood, the drying of clothes, and the performance of other important home duties. As these are not always pleasing to the sight it is desirable that this division be screened by plantings from the other divisions of the grounds.

The design on the following page shows a desirable location for a house and barn on a small suburban lot in reference to the exposure and distances from the sides and front of the lot. The first number in the mass plantings indicates the number of plants to be used, the dots showing the location of each, while the number after the dash is the index number of the kind to be used.

The drive is so designed and planted as to screen the view of the barn and its service yard from the road. The plantings consist largely of masses of hardy shrubs disposed around the foundation of the house, the boundaries and

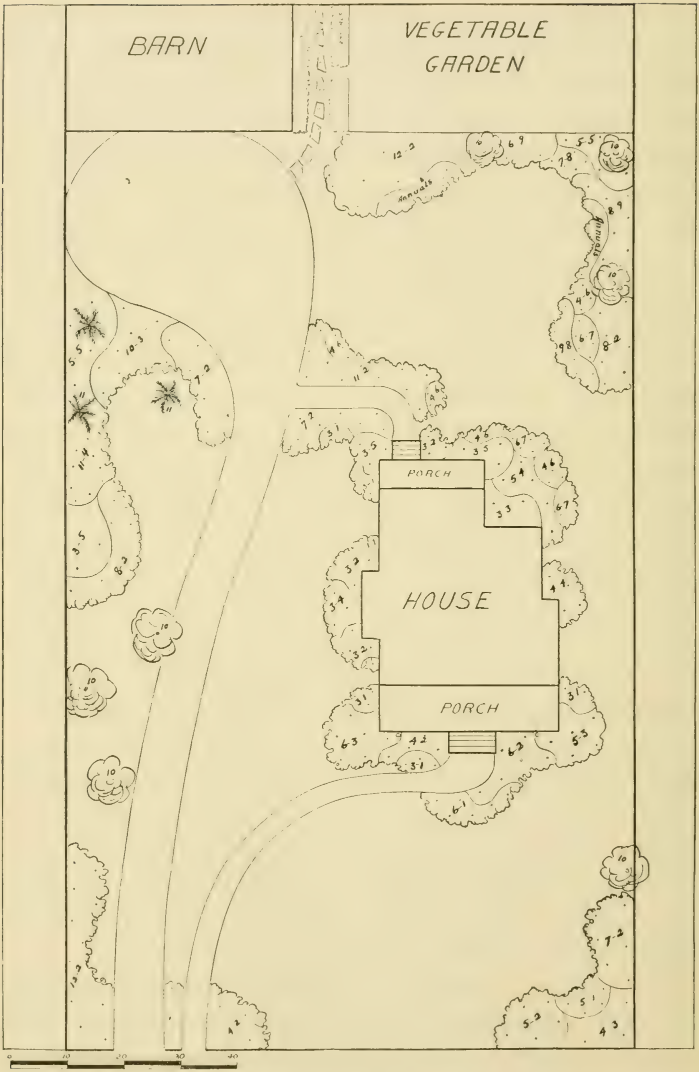

Fig. 201. — Properly planned home grounds. (For explanation of numbers see the opposite page.)

corners of the lot, leaving an unbroken lawn in front and a well screened and protected back lawn. A few trees are so disposed as to frame the view of the house from the road, to aid in screening the barn and to produce some shade over the back lawn. Hardy perennials and annuals are massed in the foreground of the shrubbery plantings about the back lawn and along the stepping-stone walk leading to the garden and back of the lot.

Index Number	Common Name of Plant	Latin Name
1	Japanese Barberry	*Berberis Thunbergii*
2	Bridal Wreath Spirea	*Spiræa Vanhouttei*
3	Tartarian Honeysuckle	*Lonicera Tartarica* var. *grand. rosea*
4	Japanese Rose	*Rosa Rugosa*
5	Lilac	*Syringa* (*In variety*)
6	Peony	*Pæonia* (*In variety*)
7	German Iris	*Iris Germanica* (*In variety*)
8	Hardy Phlox	*Phlox decussata* (*In variety*)
9	Lemoines Deutzia	*Deutzia Lemoinei*
10	Deciduous Tree	
11	Evergreen	

Another function of plantings is to enhance the elements of beauty already existing. The style of architecture of the house, the position and character of trees already on the grounds, and the slope and general topography of the land should all be carefully studied. The most pleasing lines and portions of the house should be emphasized and carefully preserved. A wide sweep of open lawn with a border and background of trees and shrubbery is always a pleasing and acceptable sight. Vistas beyond the grounds, as of a distant wood, a winding river, or a neighboring farm, are often welcome sights that add to the pleasure and value of the home. It is especially important that these

Fig. 202. — An effective screen of spruce trees.

vistas be carefully preserved. Plantings should conceal the defects and enhance the value of those parts that are most pleasing to the eye.

Mass Planting.— To obtain the desired unity, character, variety, and naturalness, the gardener relies mainly upon the use of masses. Single specimens or groups may be sparingly used, but only to break the monotony or to gain some special character in the design. Masses must be carefully designed to become expressive. The plants composing the mass should be selected with care. Each mass should consist only of a few kinds of plants. Where the mass is small it is well to select but one kind, while in larger masses more than one kind may be used to advantage. Even in the larger masses, plants of the same kind should be grouped together.

On the home grounds the larger proportion of the plantings should consist of hardy shrubs. Masses of shrubs may be used with excellent effect along the borders, in the corners, and to conceal defects and unsightly places. At the intersections of walks or drives and where a change in the direction of a walk is made, they may also be used to

Fig. 203. — A farm home. To harmonize the building with its surroundings is the function of landscape gardening.

advantage. About the base of buildings masses should be placed in such manner as to harmonize the building with its surroundings.

Selecting Plants. — After determining upon the location and size of the masses, the plants best fitted to serve these purposes should be selected. The seasonal effect is a very important consideration. One should endeavor to select those kinds that are attractive during the longest

period of the year and which make such a combination of kinds as will produce a continuous effect. Fortunately, all plants do not bloom at the same time; and the beauty of many plants consists not alone in their blossoms but in their richness of foliage, their beauty of form, and their highly colored fruit. These are the main considerations in the selection of plants for seasonal effects.

EXERCISES

1. Describe the three principal styles of landscape gardening.

2. Which would be most appropriate in the improvement of your home grounds? Why? Of the school grounds?

3. Describe a site with which you are familiar that would be ideal for a building site.

4. Where should the house be placed with reference to the barns?

5. Why should roads and walks be constructed only when they are essential?

6. When is a straight walk justifiable? A curved walk?

7. What is the best grass for lawn purposes in your locality?

8. What grass would you use in starting a lawn to gain a quick effect?

9. Describe some home grounds that are planted in a pleasing manner.

10. What are the points to consider in the selection of the kinds and varieties of plants to use in beautifying the home grounds?

11. Visit some of the neighboring home grounds and study how they might be improved by a rearrangement of the plantings.

12. Draw a map of the homestead, showing lawn, house, garden, barn, orchard, etc. Make the map scale large enough so that the details will stand out clearly.

HOME PROJECTS

1. Early in the spring apply a good dressing of well-decomposed manure to the lawn. Rake the coarsest of this off when the grass is just beginning to grow up through it and sow grass seed at the rate of 25 pounds per acre. Roll the lawn carefully. Mow it once a week or as often as is necessary to permit the clippings to remain without raking. Keep an accurate record of each operation in your notebook.

2. Draw a plan of the home grounds to a definite scale, showing the location of buildings, existing walks, drives, trees, plantings, and boundaries. Re-design the walks and drives if necessary. Design the plantings as explained in the text, giving the reason for the location, form, and size of each. Present this plan to the teacher for consultation before selecting the kinds.

CHAPTER XX

TREES, SHRUBS, VINES, AND FLOWERS

Trees. — In selecting trees for home planting the following requirements should be considered: form, hardiness, adaptability, rapidity of growth, shade production, freedom from insects and diseases, neatness, and beauty. Wild trees may be used, but they are less likely to withstand the shock of transplanting than those that have been previously transplanted in the nursery.

Fig. 204. — A beautiful giant oak tree.

The general method of planting shade trees and the precautions to be observed are the same as those for planting fruit trees. (See Chapter X.)

The Oaks. — Of all the trees that may be used on the home grounds, the oaks are undoubtedly the best. They are beautiful, long lived, and little subject to insects and disease. The white oak is probably the best known. The red oak thrives on a comparatively poor soil, develops

a straight, sturdy trunk, a symmetrical top, and its foliage turns a brilliant color in the fall. The scarlet oak is much like the red oak although smaller in size. Its foliage becomes brilliantly colored in the fall. The pin oak grows taller and more slender than most other oaks, and has an unusually straight stem. It is especially adapted for street planting and makes a very desirable lawn tree.

The Elm. — The American elm is the stateliest of trees. It prefers fertile soil and an abundance of moisture. Under these conditions, it is a comparatively rapid grower. As a street tree it combines more desirable qualities than any other, although it grows too large for narrow streets.

The Maples. — No trees have been more widely used for planting than the maples. They are very satisfactory as shade, ornamental, or street trees. The white, silver, or soft maple is largely planted because of its rapid growth, although it is a short-lived tree, very susceptible to borers, and subject to splitting and breaking. The Norway maple is the best tree for streets of moderate width and is a desirable lawn tree.

Fig. 205. — A fine specimen of sugar maple.

It is one of the first maples to come into foliage in the spring and the last to drop its leaves in the fall. The red-leaved variety of the Norway maple is an especially attractive tree. The common red maple thrives best in a moist soil and is sometimes used as a street tree although it is more suitable for lawn planting. In the fall the coloring of the foliage is brilliant, and in the spring its blossoms make a very attractive effect. The sugar maple is the most widely known and one of the best of all the maples. It is a larger tree than the Norway maple although in many other respects so much like it that the two are often hard to identify. The ash-leaved maple, or box elder, is frequently planted as a lawn tree and it adapts itself well to adverse conditions. It is a short-lived tree and is not recommended for general planting.

The Beech. — The beech makes one of the most attractive and beautiful lawn trees. The American beech is largely used, although there are many ornamental forms of the European species, such as the purple-leaved, cut-leaved, and drooping beeches that are also popular.

Other Deciduous Trees. — There are many other desirable kinds of trees which are all valuable under special conditions. When quick effects are desired, the poplars are favorite trees. The graceful white birches, the golden willows, and the stately sycamores are other attractive lawn trees.

The Evergreens. — There are few home grounds where evergreens cannot be advantageously used for producing permanent screens, windbreaks, or hedges. They are very valuable if planted sparingly about the lawn, as they contrast well with the deciduous trees and enliven the landscape during the winter season. When used too freely

about the grounds, they produce a somber effect. They should never be used near the south or east side of buildings, where they may shade them during the winter months. When placed well in the background of shrubs or deciduous trees, they give excellent results. The beauty of all evergreens depends upon the preservation of a good healthy

Fig. 206. — A windbreak of Norway spruce.

growth about the base of the tree, whether they are used as hedges, windbreaks, or lawn specimens.

The Spruces. — Spruces are the fastest growing of all evergreens, are very hardy, and for quick effects are generally the best. They are much used for windbreaks and hedges as well as for lawn planting. The Norway spruce is one of the best. It adapts itself well to any soil and almost any condition. The tree is clean, trim, and bright both in summer and winter. The trees grow big and

thick and will live long. The Colorado blue spruce is one of the most beautiful of the evergreens. The branches are produced in whorls around the trunk and the foliage is dense and of an intense blue. It thrives in almost any soil and locality, is a vigorous grower, and does well in cold, exposed situations.

The Pines. — The white pine is the most valuable species of pines. The foliage is softer and finer than that of most other evergreens. The young trees look trim and neat all the year round, and the old ones are very picturesque. The Austrian pine is a species that is especially recommended for planting in the Middle West. The growth is very dense and the trees grow to a large size. Planted singly on the lawn the trees produce a beautiful effect, and when planted in groups, the dark foliage shows in excellent contrast with spruce or other evergreens.

The Hemlocks. — These are also very popular evergreens for lawn planting and for hedges. They stand shearing well and will grow in the shade. For planting in groups with other evergreens they are excellent. The trees do best with a northern or eastern exposure, protected from drying winds. They prefer a moist soil. The trees should be frequently topped to maintain a dense growth of the lower branches.

The Arbor Vitæ. — These evergreens, commonly known as the white cedars, are quite different from other evergreens and very beautiful when properly used. They are especially valuable in grouping with other evergreens or in planting as screens or hedges. They stand pruning very well and can be trained to almost any shape.

Shrubs. — Since the planting of the home grounds necessitates the use of hardy shrubs, a few of the most important kinds are here considered.

Japanese Barberry (*Berberis Thunbergii*). — The Japanese barberry is a slow-growing shrub, especially desirable for low, ornamental hedges and for foreground planting of shrubbery masses. It is very graceful in its habit of growth, producing small, delicate, light green leaves upon gracefully drooping branches. The leaves turn a beautiful scarlet in the fall, and a brilliant winter effect is produced by the scarlet berries which remain on the twigs. It is perfectly hardy and grows well upon the lighter, well-drained soils, and is not susceptible to the San José scale.

Fig. 207. — Bridal wreath in bloom.

Bridal Wreath Spirea (*Spiræa Vanhouttei*). — This is the most popular spring-flowering spirea. Its remarkable wealth of bloom and beautiful foliage, produced on graceful branches bending to the ground, makes it exceedingly attractive. It is very hardy and grows well upon any moderately rich and well-drained soil. On good soil it is a rapid grower, attaining a height of five to seven feet. It is particularly adapted for mass planting about the porch or buildings, or along walks, drives, or the boundaries of the lawn.

Weigela (*Diervilla florida*). — The weigela is a very popular and effective free-flowering shrub, which is covered the first of June with a mass of rose-colored flowers. It grows to a height of five to seven feet, is perfectly hardy, and may be used on the north side of buildings, or in other partly shaded situations.

Golden Bell (*Forsythia intermedia*). — In very early spring, before the leaves appear, this shrub bursts into bloom with a wealth of bright golden-yellow flowers. The shrub is hardy and easily grown, even on very light soils. The plant is a vigorous grower and attains a height of six to ten feet. The foliage, being of a clean, light-green color, produces an excellent background for low-growing shrubs.

Bush Honeysuckle (*Lonicera tartarica*). — The bush honeysuckle is an excellent ornamental shrub that acquires a very graceful form. The foliage is abundant and of a dark bluish-green color. The flowers of the several varieties are white, pink, rose, or deep red, and possess a pleasing fragrance. The red, orange, or yellow berries are produced abundantly and are extremely ornamental in late summer and fall. The shrub is perfectly hardy and grows to a height of eight to ten feet.

Mock Orange or Syringa (*Philadelphus coronarius*). — There are several varieties of this well-known shrub that vary more or less in the size of their blossoms and height of the plant. It is prized especially for its fragrant white blossoms that are abundantly produced in June. It is very hardy and easily grown on almost any kind of soil. Most of the common varieties attain a height of eight to ten feet and are valuable for the background of shrubbery masses.

Yellow Currant (*Ribes aureum*). — The flowering currant is very popular as a dooryard shrub. Its fragrant yellow

blossoms and its clean-looking foliage make it very attractive. Growing only to a height of three to five feet, it is especially desirable for planting about the home and in the foreground of higher growing shrubs. It is very hardy and does well in partly shaded locations.

Hardy Hydrangea (*Hydrangea paniculata grandiflora*). — This is a very attractive shrub, producing excellent flower effects in late summer and fall. It is not entirely hardy

Fig. 208. — Japanese snowball.

in many of the northern sections and therefore needs a favored location and a rich soil. It is especially desirable for formal effects and should be pruned well back in early spring to produce the best flowers.

Japanese Rose (*Rosa rugosa*). — The Japanese rose is a favored shrub valued especially for its vigorous dark-green foliage and its large, single-petaled flowers that are produced continuously during late spring and summer. The flowers are succeeded by large red hips which are almost as

ornamental as the roses themselves. The plant is very hardy and especially beautiful when planted in masses. It grows to a height of four to five feet and does well even in partly shaded locations.

Lilac (*Syringa vulgaris*). — The lilacs are hardy plants and are especially desirable for backgrounds of shrubbery masses and for screens.

Japanese Snowball (*Viburnum tomentosum plicatum*). — The flowers of this shrub are similar to the common snowball, but seem larger and of a purer white against the heavy dark-green foliage. It grows to a height of eight to ten feet and thrives well along the north side of buildings or other partly shaded locations. It is not entirely hardy in the northern districts. Unlike the common snowball it is seldom troubled with plant lice.

Spirea Anthony Waterer. — This spirea is a low, summer-flowering shrub, blooming from the middle of June until fall. It is an excellent hardy shrub for summer effect and especially adapted for the foreground planting of shrubbery masses.

Ornamental Vines. — Vines are as necessary as trees and shrubs in landscape decoration. By toning down the stiff, bold angles and bare surfaces of buildings, they produce a harmonious effect that can be obtained in no other way. On small places they are particularly valuable. They grow rapidly where other ornamental plants would have no room for development, and display their beauty on steep walls, columns, and trellises. If correctly placed, they embellish rather than conceal the architecture. By planting the less sightly portions and leaving the more beautiful elements of the building exposed, even the most ordinary-looking houses may often be made attractive.

Many of the vines, as the wistaria, climbing roses, and clematis, prefer a southern exposure, while the woodbine and American ivy thrive in shady places. For covering screens, stumps, rocky places, bare tree trunks, walls, and fences they are excellent.

Of the flowering vines the clematis is one of the most popular. There are two classes of this vine, commonly known as the large-flowering and the small-flowering clematis. *Clematis Jackmanii* is one of the best of the large-flowering varieties, while *Clematis paniculata* is the most popular of the small-flowering clematis.

Fig. 209. — A beautiful effect produced by ivy.

The wistaria is another one of the most beautiful and effective of the flowering vines, but it is rather slow in coming into blossom, frequently requiring five to six years. It prefers a southern exposure and a moderately rich, well-drained soil.

The honeysuckle thrives and blooms abundantly either in a southern exposure or in shaded or partly shaded locations. Even upon poor soil on the north side of buildings the honeysuckle grows better than most other vines. It is a desirable vine for porches, screens, walls, or for covering bare places under trees.

Roses are an extremely popular class of vines although they require much care. A southern exposure is preferred with a moderately rich clay loam soil. The Crimson

Rambler, Dorothy Perkins, and Lady Gay are three of the most beautiful climbing roses. These vines are not so susceptible to mildew as some of the other varieties, and are vigorous, hardy, and very free flowering.

Annual vines are often desirable when producing quick effects. Screens may be temporarily produced by them until perennial vines become established. Of the annual vines

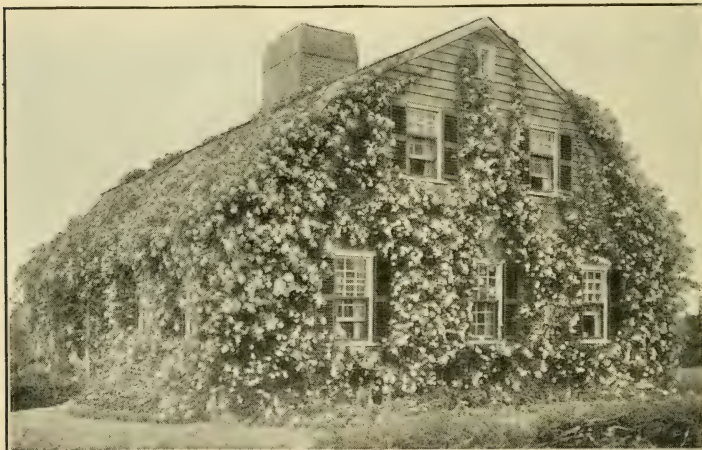

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Fig. 210. — Dorothy Perkins rose vines.

the flowering nasturtium, morning glory, wild cucumber, moon vine, and cobea are especially valuable. Moon vines and cobea, started indoors three to four weeks before planting outside, will often grow twenty to twenty-five feet in a single season.

Hardy Perennials. — There is not a time during the whole season in which some hardy perennial is not in bloom. During the months of July and August, when almost all the woody shrubs have ceased blooming, these

plants may be depended upon to make a flower display. When once planted, they appear year after year and flower abundantly. Their ability to thrive with little care makes them a desirable class of plants for the home grounds. For any soil or any location there is to be found some perennial adapted to the conditions.

Perennials are especially suitable for border planting, and when placed in front of shrubbery masses, they are very effective. They may be used along garden walks, walls, fences, against buildings, and in other places about the home grounds. Many of the perennials can be grown from seed.

Of the old-time favorites there are the foxglove, hollyhock, Sweet William, and phlox. Then there are the columbine, blanket-flower, coreopsis, peony, and poppy, all favorites for their flowering effects. For planting about ponds or upon deep, moist soil there are the iris, forget-me-not, lily-of-the-valley, bee balm, trillium, cardinal flower, and the ornamental grasses; and for late summer and fall effects we have the hardy chrysanthemum, golden glow, and aster enriching the landscape with their brightness of color.

Annuals. — Annuals are essential for producing the best and most continuous display of flowers during the summer months. They are also especially valuable in producing quick effects. When planted in the foreground of shrubs or among perennials, they produce a pleasing effect. In the free and natural style of landscape gardening they should be planted along the borders of other plantings, and when so arranged enhance the beauty of the entire design.

Annuals are very easy to grow. Almost all of them may be grown successfully by sowing the seeds directly in

permanent beds; but usually better plants are obtained by seeding in hotbeds or boxes of earth and transplanting to the open ground. Frequently the plants come into blossom a month earlier when grown in this manner, and a longer flowering season is thus obtained.

The kinds of annuals are so numerous that a selection is largely a matter of personal preference. The sweet alyssum, dusty miller, candytuft, and lobelia make excellent edging plants. For summer flower displays, nasturtium, petunia, coxcomb, verbena, annual phlox, poppy, salvia, zinnia, and balsam are all easily grown and very effective. Portulaca is well adapted for covering dry, sandy banks. Heliotrope, marguerite, and mignonette furnish our gardens with delightful fragrance.

EXERCISES

1. Name some of the important spring flowering shrubs, both wild and cultivated, of your locality. Name some of the summer and fall flowering shrubs.

2. Do you know of any ornamental shrubs of special value for their foliage effects? For their fruit? For the color of their bark?

3. Name some shrubs especially valuable for hedges.

4. Name some shrubs used for the foreground planting of masses. For background planting.

5. Name as many shrubs as you can that are planted on your home grounds. On the school grounds.

6. What is a deciduous tree?

7. Explain the proper method of transplanting a tree.

8. Name and describe some trees that are valuable as street trees. As lawn trees.

9. Name and describe from sample branches six important ornamental vines of your locality.

10. Name the kinds of perennials growing on your home grounds.

FLOWER GARDEN MAKING CONTEST

(Adapted from "Educational Contests in Agriculture and Home Economics." Office of Experiment Station, Bulletin 255.)

Rules Governing the Contest

1. Requirements for entry:

(*a*) All contestants shall be between the ages of 12 and 20 years.

(*b*) Each contestant shall be given a plot of ground, of the size specified by the committee in charge, located at the home of the contestant, on which to grow flowers, the seeds to be furnished by the committee in charge; each contestant to plant, cultivate, and care for the plot assigned without any outside assistance.

(*c*) Each contestant shall keep an accurate record of the time devoted to the garden, the varieties planted, the yield of each variety, the cost of seed, etc., and shall submit his record to the committee in charge.

(*d*) Each contestant shall be required to write an essay of not more than 500 and not less than 300 words, describing the work in the garden, the time applied, and the pleasure derived from observing the growth of the flowers. These essays shall be submitted to the persons in charge not less than three days before the date of the contest awards.

2. Basis of Awards:

Essay and record	10%
Grouping of flowers	25%
Success in cultivation	40%
Color scheme of flowers	25%
Total	100%

APPENDIX

I. PLANTING TABLE FOR FLOWERS

Name of Flower	Time to Sow		Depth to Plant	Time of Flowering		Color of Flowers	Height (feet)
	In-doors	Out-doors	(inches)	Early Crop	Main Crop		
Alyssum sweet . .	Mar.	Apr. Sept.	½	July	Aug.	White	½
Aster China . .	Feb. Apr.	May	½	July to Aug.	Sept. to Oct.	blue, red white	1
Balsam . .	Mar.	May	½	May	July	red, white, pink	2
Carnation (Marguerite)	Feb.	Apr.	½	July	Sept.	pink, red, white, var.	¾
Candytuft		Apr. July	¼		June to Sept.	red, white	½
Castor Oil	Mar. May	June	2			insignificant	2 to 8
Cosmos .	Feb. Apr.	May	¼	Aug.	Oct. to Nov.	pink, white, yellow	4 to 10
Foxglove .	Jan.	May	not covered	Aug.	July of following year	pink, white	2 to 4
Lobelia cardinalis	Aug.	Apr.	¼	Next July	Aug.	carmine	¾
Mignonette	Feb. Mar.	Apr. May	¼	May to July	July to Oct.	greenish	1
Morning-glory . .	Feb. Apr.	May	1	July	Aug. to Oct.	blue, red, white, var.	15 to 30
Nasturtium	Mar. Apr.	May	1	June	July to Oct.	scarlet, yellow, maroon	1 to 5
Pansy . .	Jan. Feb.	June July	⅛	May to June	Sept. to Oct.	purple, blue, white, yellow	½ to 1
Petunia .	Mar. Apr.	May	not covered	May	Sept.	magenta, white	1 or 2
Phlox, annual .	Feb.	Mar. May	⅛	May	July to Aug.	white, red, yellow, maroon	½ to 1

II. PLANTING AND SEED TABLE

Name of Vegetable	Date of Planting				Depth of Planting (inches)	Distance Apart of Rows (feet)
	Seeds, first crop	Plants, first crop	Seeds for succession	Fall and winter use		
Beans, bush	May		June		1–2	2½–3
Beans, pole and Lima	May 15–31	May 20–31			1–2	3–4
Beets	April 15–30		May–June	July–Aug.	½–¾	2½–3
Brussels sprouts		May				2½–3
Cabbage, early		April 15–30				2½–3
Cabbage, late		May	June (plants)			2½–3
Carrots	May				¼–½	2–2½
Cauliflower		May				2½–3
Celery, early		April 15–30				2½–5
Celery, late				June (plants)		3–5
Corn, early	May 1–15		June		1–1½	2½–3
Corn, late	May 15–31		June		1–1½	2½–3
Cucumbers	May 15–31	May 20–31		June	¾–1	4–6
Eggplant		May 20–31				3–4
Endive		April 20–30		July–Aug.	½–¾	2½–3
Kale	May				½–¾	2½–3
Kohl-rabi		May 1–15	June (plants)			2½–3
Lettuce	April 15–30	April 20–30	May	June–July	¼–½	2½–3
Muskmelon	May 15–31	May 20–31			¾–1	4–6
Okra		May 15–31				2½–3
Onion, sets	April 15–30		May–June	Sept.	½–¾	2½–3
Onion, seeds	May				¼–½	2½–3
Parsley	April 15–30			June	½–¾	2½–3
Parsnips	May				½–¾	2½–3
Peas, early	April 15–30				1–2	2½–3
Peas, late	May 1–15		May 15–June		1–2	2½–3
Peppers		May 15–31				2½–3
Potatoes, early	April 15–30				2–3	2½–3
Potatoes, late	May			June	4–5	2½–3
Pumpkins	May 15–31				1–1½	6–10
Radishes, early	April 15–30				½–¾	2½–3
Radishes, medium and late	May		June	June	½–¾	2½–3
Rutabaga	April 15–30			June 10–20	½–¾	2½–3
Salsify	May 1–15				½–¾	2½–3
Spinach	April 15–30			Aug.–Sept.	½–¾	2½–3
Squash	May 15–31	May 20–31			1–1½	3–8
Sweet potatoes		May 15–31				2½–3
Tomatoes		May 15–31				3–5
Turnips	April 15–30		May	July–Aug.	½–¾	2½–3
Watermelons	May 15–31				¾–1	6–8

From Bulletin, "The Home Vegetable Garden" by C. W. Waid, Michigan Agricultural College.

FOR VEGETABLES FOR THE HOME GARDEN

Distance Apart of Rows	Distance Apart of Plants in Rows		For a 100 Foot Row		Ready to Use after Planting (days)	Seeds in 1 Ounce	Wt. of 1 Qt. Seed (oz.)	Average Time to Germinate (days)	Germination of One-Year-Old Seed (per cent)	Length of Time Garden Seed Can Be Kept (years)
Hand cultivation (inches)	Hills	Drills	Seeds	Plants						
18–30	8–12	3–4	1–2 pt.	100–150*	45–65	200–250	30	5–10	90	3
24–36	18–30	5–6	1 pt.	35–65*	50–80	150–200	30	5–10	90	3
18–24	......	2–3	2 oz.	80–100	60–85	1,500	10	7–10	140	4
18–30	18–24	......	¼ oz.	50–75	95–120	......	25	5–10	90	3
18–30	12–18	......	¼ oz.	50–90	90–105	8,500	25	5–10	90	3
18–30	18–24	......	¼ oz.	50–75	100–150	8,500	25	5–10	90	3
18–24	......	3–4	½ oz.	......	75–110	20,000	9	12–18	80	1
18–30	18–24	......	¼ oz.	50–75	100–130	10,500	25	5–10	80	4
18–30	......	4–5	¼ oz.	250–300	120–130	20,000	14	10–20	60	2
18–60	......	5–6	¼ oz.	200–250	130–150	20,000	14	10–20	60	2
24–36	18–24	8–10	½ pt.	50–65*	65–90	......	20	5–8	85	1
24–36	24–36	10–12	½ pt.	35–50*	75–100	......	20	5–8	85	1
48–60	48–60	12–18	½ oz.	80–100*	60–80	1,000	18	6–10	85	5
24–36	24–36	......	¼ oz.	25–50	150–160	7,800	18	5–10	75	5
12–18	......	12–18	1 oz.	75–100	90–130	18,000	12	5–10	85	2
18–30	......	8–15	⅓ oz.	80–150	90–120	8,500	25	5–10	90	2
18–30	12–18	6–8	½ oz.	120–150	60–80	8,500	25	5–10	90	1
12–18	......	4–12	⅓ oz.	100–300	60–90	23,000	15	6–8	85	4
48–60	48–60	12–18	1–2 oz.	20–25*	120–150	1,600	13	7–10	85	5
18–30	18–30	......	¼ oz.	40–50	......	500	22	6–10	80	4
12–18	......	2–3	2½ qt.	......	25–50	......	...	......	......	1
12–18	......	1½–2	¾ oz.	......	130–150	7,000	18	7–10	80	1
12–18	......	6–10	½ oz.	120–200	90–120	......	18	10–18	70	1
18–24	......	3–4	½ oz.	......	125–160	7,000	15	10–10	70	1
18–30	......	Drilled	1 qt.	......	40–80	50–150	28	6–10	90	3
24–36	......	Drilled	1 qt.	......	65–90	50–100	25	6–10	90	3
18–30	15–18	......	¼ oz.	65–80	100–140	4,500	16	9–14	75	3
18–30	9–15	......	8–10 lb.	......	80–100	......	...	......	......	1
24–30	12–18	......	8–10 lb.	......	100–140	......	...	......	......	1
72–96	72–96	......	1 oz.	12–15*	100–140	......	9	7–10	85	3
12–18	......	Drilled	1 oz.	......	30–40	10,000	25	3–6	90	2
12–18	......	Drilled	1 oz.	......	35–50	10,000	25	3–6	90	2
18–24	......	6–10	1 oz.	120–200	75–100	13,000	25	4–8	85	4
18–24	......	3–4	1 oz.	......	120–180	3,000	8	7–12	75	2
18–24	......	4–6	1 oz.	......	30–60	2,500	13	7–12	80	2
36–96	36–84	......	4 oz.	15–35*	60–125	100–500	15	7–10	85	3
24–36	......	14–18	......	65–75	120–130	......	...	......	......	1
24–36	18–36	......	¼ oz.	35–75	100–140	10,000	11	6–12	85	5
18–24	......	4–6	½ oz.	......	60–80	13,000	24	4–8	85	4
60–72	60–72	......	3–4 oz.	16–20*	100–150	125–150	16	7–10	85	5

* Hills.

III. Legal weight per measured bushel in most states for the common field seeds, and rate of seeding per acre

	Pounds per Bushel	Rate of Seed per Acre
Alfalfa, humid sections	60	15 to 25 lb.
Alfalfa, semiarid	60	2 to 10 lb.
Alsike clover	60	6 to 10 lb.
Barley	48	$1\frac{1}{2}$ to 2 bu.
Corn in ear	70	8 to 12 lb.
Corn shelled	56	8 to 12 lb.
Mammoth clover	60	10 to 12 lb.
Oats	32	2 to 3 bu.
Peas	60	2 to $3\frac{1}{2}$ bu.
Potatoes	60	10 to 15 bu.
Red clover	60	10 to 12 lb.
Soy beans, broadcast	60	90 lbs.
Soy beans, in drills	60	20 to 60 lb.
Timothy	45	10 to 12 lb.
Vetch	60	30 to 60 lb.
Wheat	60	$1\frac{1}{2}$ to 2 bu.

INDEX

INDEX

Agronomy, 11
Alfalfa, 141
  acreage to sow, 154
  artificial cultures for inoculation, 156
  beneficial effect on soil, 142
  curing, 150
  danger of bloat, 152
  depth to sow, 146
  enemies, 159
  exercises, 159
  fall plowing, 143
  feeding value, 157
  growth, habits of, 141
  hard seeds, 145
  home projects, 160
  inoculation methods, 155
  loss of feeding value, 151
  nitrogen gatherer, 141
  rate of seeding, 146
  root system, 141, 142
  rotation, 156
  seed bed, 142
  seed production, 152
  seed testing, 144
  seeding methods, 148
  soil acidity, 158
  soil inoculation, 154
  soiling and pasture crop, 152
  sowing with nurse crop, 147
  sowing without nurse crop, 145
  spring plowing, 143
  stacking alfalfa, 153
  sweet clover soil for inoculation, 154
  tester, simple plate, 144
  varieties, 141
Alsike clover, 125
  adaptation, 126
  description, 125
  uses, 126
Annuals, 408
Aphis, 272
Apples, 301
  care of trees, 249
  cultivation, 304
  planting, 302
  propagation, 302
  varieties, 244, 304
Arbor vitæ, 402
Arsenate of lead, 286
Artificial cultures for inoculation, 156

Bacterial diseases, 278
Barberry, Japanese, 403
Barley, 79
  classification, 80
  diseases, 85
  habits of growth, 81
  harvesting, 82
  history, 79
  home projects, 89
  hot-water treatment for smut, 86
  insect enemies, 85
  judging, 60
  marketing, 84
  rotation, 84
  score card, 87
  scoring, 88
  shocking, 83
  smut, 85, 86
  soil, 81
  sowing seed, 82
  straw, objections to, 82
  testing the seed, 82
  threshing, 84
  treatment for smut, 85
  trueness to type, 60
  variety differences, 84
Beech, 400
Bees in white clover regions, 126
Bitter rot, 276
Blackberries, 333
  culture, 333
  propagation, 333

Blackberries — *Continued*
pruning, 334
soil, 333
varieties, 335
Black knot, 278
Blight, leaf, 278
Blue grass (*see* Kentucky blue grass)
Bordeaux mixture, 283
Borers, 273
Brambles, 333
Breeding, 39, 112
centgener method, 112
corn, 39, 50
grain, 112
Bridal wreath spirea, 403
Bridge grafting, 235
Brome grass, 169, 170
contamination of seed, 169
harvesting, 170
history, 169
rotation, 170
Brown rot, 276
Buckwheat, 107
adaptation, 108
enemies, 110
exercises, 110
growth, habits of, 107
harvesting, 109
history, 107
home projects, 111
rate of seeding, 109
rotation, 110
seed bed, 108
sowing seed, 109
threshing, 109
uses, 110
varieties, 107
Budding, 230
cutting buds, 231
inserting buds, 231
selecting buds, 231
Bulb, 210
Bulbels, 211
Bulblet, 211
Bush fruits, 329
Bush honeysuckle, 404

Cankerworm, 269
Capillary water, 13
Centgener method of breeding, 112
Cherries, 315
culture, 315
Cherries — *Continued*
harvesting, 316
soil, 315
Chewing insects, 268
Cleft grafting, 235
Clematis, 407
Clover, 120
alsike, 125
mammoth, 125
red, 120
redtop, 171
Codling moth, 268
Cold frames, 361
Colorado beetle, 180
Commercial fertilizers for vegetables, 350
lime, 351
nitrogen, 350
phosphorus, 351
potassium, 351
Coöperation in marketing, 378
Copper sulphate solution, 283
Cormels, 211
Corms, 211
Corn, 17
acclimatization, 50
breeding, 39, 50
butts, 50
checking, 27, 32
circumference of ear, 54
classification, 17
cob, 47
color of grain and cob, 47
"corn tree," 36
cultivation, 27
culture, 24
curing seed, 32
dent corn, 20
devices for curing, 35
drilling, 27
ear-to-row method of breeding, 39
exercises, 37
flint corn, 19
fodder, 28
germination, 31
growth, habits of, 21
harvesting, 28
harvesting for silage, 29
height of ear, 33
history, 17
home projects, 38
improvement, 41

Corn — *Continued*
judging, 41, 49
kernels, 52, 61
leaves, 22
length of ear, 54
market condition, 49
mixture, 49
moisture in seed, 34
oil in kernels, 24
percentage of grain to cob, 57
planting, 26
plowing for, 24
pod corn, 17
pollination, 23
pop corn, 18
purity, 23
roots, 22
rules for judging, 45, 59
sample for exhibition, 42
score card, 43
scoring, 41, 59
seed curing, 32, 35
seed moisture, 34
seed selection, 30, 32, 41
seed storage, 34
seed testing, 30
shape of ear, 46
silage, 29
soft corn, 18
space between kernels, 56
space between rows, 55
stover, 28
sweet corn, 19
testing the planter, 26
tillering, 22
tips, 50
type, 46
uses, 24
varieties, 21
vitality, 32, 33
Yankee, 19
Cotton, 188
breeding, 193
characteristics, 188
climatic conditions, 194
cultivation, 195
diseases, 199
exercises, 200
fiber, 190
flowers, 188
harvesting, 196
home projects, 200
Cotton — *Continued*
insect enemies, 198
long-staple, 191
marketing, 198
planting, 195
seed, 191
soils, 194
uses, 198
varieties, 189, 191
Cover crops, 104
for garden, 352
for humus, 352
for orchard, 256
plowing under, 258
seed table, 258
Crops, leguminous, 120
Cross breeding, 117
Crown gall, 281
Crowns, 212
Cultivation, 15, 304
orchard, 253
peach, 312
vegetable garden, 355
Currants, 329
diseases, 332
fertilizers, 331
harvesting, 331
insects, 332
pruning, 330
spraying, 332
Cuttings, 217
classification, 220
exercises, 226
external requirements, 217
hardwood, 222
heel, 224
home projects, 226
leaf, 221
mallet, 224
moisture, 219
one-eye, 224
root, 221
simple, 223
softwood, 225
soil, 219
stem, 222
temperature, 217
tuber, 220

Dewberries, 333
culture, 333
propagation, 333

Dewberries — *Continued*
pruning, 334
soil, 333
Diervilla, 404
Diseases, alfalfa, 159
barley, 85
cotton, 198
fruit, 274
fungous, 274
potatoes, 180
wheat, 76
Dissemination of seeds, 119
Distances of planting fruits, 244
Distribution of produce, 379
Division as means of propagation, 212

Elm, 399
Enemies of the pomes, 306
Ergot, 105
Evergreens for home planting, 400
Exercises, 16, 37, 65, 99, 106, 110, 119, 139, 159, 187, 200, 208, 215, 226, 238, 250, 265, 281, 289, 299, 308, 317, 336, 346, 353, 358, 367, 374, 381, 396, 410

Fertility, maintaining orchard, 255
Fertilizers, 15
barnyard manure, 259
commercial, 259, 350
cover crops, 256
essential, 15
for alfalfa, 147
for lawns, 387
for vegetables, 348
Fire blight, 278
Flats for starting plants, 372
Flower garden making contest, 411
Flowering currant, 404
Forsythia, 404
Fruit, diseases, 274
grading, 296
growing, 240
insects, 267
packages, 297
packing, 297
pests, 267
storage, 298
thinning, 291
Fruits, bush, 329
Fungus, shot-hole, 277

Germination, requirements, 203
tests, 202
time required, 205
Glass structures, 360
Golden bell, 404
Gooseberries, 329
diseases, 332
fertilizers, 331
harvesting, 331
insects, 332
pruning, 330
spraying, 332
Grading fruits, 296
Grafting, 228
bridge, 235
cleft, 235
functions, 228
inserting buds, 232
limitations, 229
tongue, 234
Grain breeding, 112
centgener method, 112
crossing method, 117
dissemination, 119
exercises, 119
head-to-row method, 114
home project, 119
selection method, 112
Grapes, 319
culture, 319
diseases, 322
insects, 322
propagation, 319
pruning, 320
score card, 336
spraying, 323
Greenhouse, construction, 363
soils, 364
temperature, 365
watering, 366

Hardy hydrangea, 405
Hardy perennials, 408
Harvesting, alfalfa, 149
barley, 82
brome grass, 170
buckwheat, 109
corn, 28
fruits, 293
oats, 94
peas, 131
potatoes, 181, 182
red clover, 122
redtop, 172
rye, 103

Harvesting — *Continued*
soy beans, 137
timothy, 163
vegetables, 376
wheat, 73
Hay crops, 161
alfalfa, 149
clovers, 120, 126
rye, 104, 128
soy beans, 134
vetch, 128
Head-to-row breeding, 114
Heeling in, 246
Hellebore, 287
Hemlock, 402
Home gardening, 337
Home projects, 16, 38, 66, 78, 89, 100, 106, 111, 119, 140, 160, 172, 187, 200, 209, 216, 226, 239, 251, 266, 282, 290, 300, 309, 318, 336, 353, 359, 367, 397
Honeysuckle, bush, 404
Horticulture, 201
Hotbeds, 360
Hydrangea, hardy, 405

Inarching, 237
Inoculation of soil, 155
for alfalfa, 156
for soy beans, 138
Insect enemies, alfalfa, 159
barley, 85
cotton, 198
orchards, 267
potatoes, 180
stone fruits, 316
wheat, 76
Insects, chewing, 268
Irrigation of vegetable gardens, 354

Japanese barberry, 403
Japanese rose, 405
Japanese snowball, 406
Judging corn, 41
Judging small grains, 59, 66
color, 61
damaged kernels, 64
exercises, 65
freedom from mixture, 61
freedom from weed seed, 63
hardness and texture, 64
home projects, 66
odor, 64
score cards, 65

Judging small grains — *Continued*
size of kernels, 61
trueness to type, 60
uniformity in size and shape, 61
viability, 64
weight per bushel, 63

Kentucky blue grass, 166
harvesting for seed, 168
hay crop, 166
lawn grass, 168
pasture, 166
rate of seeding, 168
soil adaptation, 169
uses, 168
weight of seed per bushel, 168

Landscape gardening, 382
formal style, 382
lawn, 387
mass planting, 394
natural style, 382
picturesque style, 382
planting the grounds, 390
selecting plants, 395
walks and drives, 386
Landscape planting plan, 392
Lawn grass, 168, 387, 389
Lawns, 387
Layerage, 213
air, 215
mound, 215
serpentine, 215
simple, 214
tip, 214
Laying out the orchard, 247
Leaf blight, 278
Leguminous crops, 120
Lilac, 406
Lime, 15
Lime-sulphur sprays, concentrated, 288
dilute, 285
self-boiled, 284
strong, 287
"Little peach," 280
Longevity of seeds, 203

Maintaining orchard fertility, 255
Mammoth clover, 125
Manure as fertilizer, 15, 147, 348
Maples, 399
Market gardening, 338
Marketing, 84

Marketing — *Continued*
barley, 84
cotton, 198
timothy, 164
vegetables, 377
Mass planting, 394
Mixing fertilizers, 352
Mixtures, grass, 162
Mock orange, 404
Moisture for seeds, 203
Moth, codling, 268
Mowing lawns, 390

Nitrogen, 11, 15
Nurse crop, alfalfa, 145
barley, 82
oats, 94
rye, 103, 127

Oaks, 398
Oats, 91
diseases, 95
exercises, 99
growth, habits of, 92
harvesting, 94
history, 91
home projects, 100
immunity to rust, 96
judging, 60
Kherson, 94
nurse crop for clover, 94
rate of seeding, 94
rotation, 95
rust, 95
score card, 98
scoring, 98
smut, 96
soil, 94
threshing, 94
treatment for smut, 97
varieties, 92
Orchard, fertility, 255
maintenance, 249
management, 253
site selection, 240
Orchard grass, 170
character of plant, 170
hay, 171
rate of seeding, 171
sowing seed, 171
uses, 171
Oxygen for germination, 204

Packages for vegetables, 376
Packing fruits, 297
Paris green, 286
Pasture crops, 161
alfalfa, 151
grasses, 161
rye, 104, 128
timothy, 165
Peach, culture, 310
cultivation, 312
planting, 310
pruning, 311
rules for planting, 310
varieties, 313
yellows, 280
Peach-leaf curl, 277
Pears, culture, 305
planting, 305
propagation, 305
pruning, 305
varieties, 306
Peas, 129
canning, 131
classification, 129
field, 131
growth, habits of, 129
harvesting, 131
rate of seeding, 130
rotation, 132
seed bed, 129
soil requirements, 130
sowing seed, 130
threshing, 131
uses, 132
varieties, 129
Perennials, hardy, 408
Philadelphus, 404
Phosphorus, 11, 15
Picking fruits, 293
Pines, 402
Planning fruit garden, 241
Plant lice, 272
Planting, alfalfa, 146
apple trees, 302
barley, 82
buckwheat, 109
corn, 26
cotton, 195
fruit trees, 247
home grounds, 390
peaches, 310
peas, 130

Planting — *Continued*
potatoes, 177
red clover, 121
soy beans, 136
timothy, 162
wheat, 71
Planting tables, flowers, 413
vegetables, 414
Plowing, for alfalfa, 143
for corn, 24
vegetable garden, 354
Plum curculio, 270
Plums, culture, 314
soil, 314
varieties, 313
Pollination of corn, 23
Pomes, 301
enemies of, 306
Potash, 11, 15
Potatoes, 174
arsenate of lead, 181
blight, treatment for, 180
breeding, 183
classification, 174
Colorado beetle, 180
diseases, 178
diseases, prevention of, 178
exercises, 187
feed for animals, 176
growth, habits of, 175
growth, period of, 175
harvesting, 181
history, 174
home projects, 187
improvement, 182
insect control, 180
methods of planting, 177
new varieties, creating, 175
Paris green, 181
planting, 177
scab, treatment for, 180
score card, 185
seed, 175
seed bed, 177
spray solutions, 179
storage, 176, 182
uses, 176
Preparation of orchard soils, 246
Propagation, 305
air layering, 215
by cuttings, 218
by division, 212
Propagation — *Continued*
by layerage, 213
by seeds, 201
by separation, 210
mound layering, 215
of apples, 302
of blackberries, 333
of dewberries, 333
of pears, 305
of raspberries, 333
serpentine layering, 215
simple layering, 214
tip layering, 214
Protein food, 135
Pruning bearing trees, 263
functions, 261
method, 264
orchards, 260
peaches, 311
season, 263

Quinces, 306

Raspberries, 333
culture, 333
propagation, 333
pruning, 334
soil, 333
varieties, 335
Rate of seeding, alfalfa, 146
buckwheat, 109
Kentucky blue grass, 168
oats, 94
peas, 130
red clover, 121
redtop, 172
rye, 102
wheat, 73
Red clover, 120
adaptation, 120
curing the hay, 122
cutting stage, 122
hay, 122
mixture with timothy, 121
rate of seeding, 121
second cutting, 122
seed, 123
sowing seed, 121
time of seeding, 121
yield of seed, 123
Redtop, 171
harvesting, 172

Redtop — *Continued*
rate of seeding, 172
soil adaptation, 171
sowing seed, 172
Rootstock, 212
Rose, climbing, 407
Japanese, 405
Rotation, alfalfa, 156
barley, 84
buckwheat, 110
cotton, 196
oats, 95
peas, 132
rye, 101
timothy, 162
wheat, 75
Rules for planting peach, 310
Rust, oat, 95
rye, 106
wheat, 76
Rye, 101
classes, 101
cover crop, 104
diseases, 105
ergot, 105
exercises, 106
growth, habits of, 101
harvesting, 103
hay crop, 104
home projects, 106
judging, 60
nurse crop, 103, 127
pasture crop, 104, 128
rate of seeding, 102
rotation, 101
rust, 106
seed beds, 101
straw, 105
threshing, 103
uses, 103

Scab, 180, 275
School gardening work, 347, 358, 367, 375
Seed bed, alfalfa, 142
buckwheat, 108
corn, 24, 27
peas, 129
potatoes, 177
rye, 101
vetch, 129
wheat, 70
Seed longevity, 203
Seed production, alfalfa, 152
corn, 30, 41
red clover, 123
timothy, 165
vetch, 128
Seed sowing, 368
Seed, storage, 206
corn, 34
potatoes, 176, 182
soy beans, 138
Seed stratification, 207
Seed table, 374, 413, 414
Seed testing, 201
barley, 82
corn, 30
timothy, 161
wheat, 82
Selecting plants—landscape planting, 395
Selection, breeding by, 112
of building sites, 384
Separation, propagation by, 210
Shot-hole fungus, 277
Shrubbery planting, 395
Shrubs, 402
Silage, 29
Smut, barley, 85, 86
oats, 96
wheat, 76
Snowball, 406
Soil, color, 12
composition, 11
kinds, 12
mulch, 15
water, 13
Soil requirements, alfalfa, 142
alsike clover, 126
barley, 81
buckwheat, 108
corn, 25
cotton, 194
mammoth clover, 125
oats, 94
orchard, 246
orchard grass, 170
peas, 130
red clover, 120
redtop, 172
rye, 101
white clover, 126
Sowing lawn seed, 390
Soy beans, 132
classification, 133

Soy beans — *Continued*
composition, 134
cultivation, 136
description, 133
digestible nutrients, 136
exercises, 139
growth, habits of, 133
harvesting, 137
hay, 134, 135
history, 132
home projects, 140
planting, 136
protein food, 135
soil inoculation, 138
storing, 138
threshing, 138
uses, 134
varieties, 134
Spirea, 403
Anthony Waterer, 406
Splice grafting, 233
Spores, propagation by, 207
Spraying mixtures, 283
Spruces, 401
Stable manure for vegetables, 348
Stolons, 212
Stone fruits, 310
cherries, 315
diseases, 316
insects, 316
peaches, 310
plums, 313
Storage, fruit, 298
vegetables, 380
Stratification of seeds, 207
Strawberries, 324
cultivation, 327
culture, 324
diseases, 328
insects, 328
soil, 324
varieties, 328
Sucking insects, 271
Syringa, 404
Systems of orchard planting, 242
alternate, 243
distances between trees, 243
hexagonal, 243
square, 242

Temperature requirements of seeds, 204
Tent caterpillar, 270
Thinning fruits, 291
Threshing, barley, 84
buckwheat, 109
oats, 94
peas, 131
rye, 103
soy beans, 138
wheat, 73
Tillage of vegetable gardens, 354
cultivation, 355
harrowing, 354
plowing, 354
Time, for planting orchards, 246
for planting seeds, 374
Time required for germination, 205
Timothy, 161
cutting and curing, 163
growth, habits of, 166
harvesting for seed, 165
marketing hay, 164
mixture, 162
naked seeds, 161
pasturing, 165
rotation, 162
side-delivery rake, 164
sowing seed, 162
storing hay, 164
testing seed, 161
varieties, 161
Tobacco, 288
Tongue grafting, 234
Transplanting vegetables, 370
Trees for landscape planting, 398
Truck gardening, 338
Tuber, 212

Varieties, of apples, 304
of peaches, 313
of plums, 313
selecting, 244, 340
Vegetable forcing, 340
Vegetable garden, climate, 342
destroying insects, 345
location, 341
plan, 342
planning, 343
preventing diseases, 344
rotation, 344
selecting varieties, 340
Vegetable gardening, 337
Vegetable packages, 376
Vegetable storage, 380

Vetch, 126
  hairy, 127
  kinds, 129
  rate of seeding, 127
  seed description, 128
  seed production, 128
  sowing seed, 127
  uses, 128
Viability, 64, 82
Vines, ornamental, 406

Walks and drives, 386
Webworm, 270
Weights, table of, 416
Wheat, 67
  bluestem, 69
  classification, 67, 69
  durum, 69
  enemies, 76
  Fife, 69
  Fultz, 67
  grading, 71

Wheat — *Continued*
  growth, habits of, 70
  harvesting, 73
  history, 67
  home projects, 78
  insect pests, 76
  judging, 60
  Marquis, 69
  rate of seeding, 73
  rotation, 75
  score card, 77
  scoring, 76
  seed bed, 70
  sowing seed, 71
  testing seed, 71
  threshing, 73
  varieties, 67
  velvet chaff, 69
White cedar, 402
White clover, 126

Yellow currant, 404